Cognition 226 (2022) 105167

Contents lists available at ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/cognit

How causal structure, causal strength, and foreseeability affect moral judgments

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ARTICLE INFO

Keywords:
Causal reasoning
Moral judgment
Causal chains
Foreseeability
Causal proximity
Indirect harm

ABSTRACT

Causal analysis lies at the heart of moral judgment. For instance, a general assumption of most ethical theories is that people are only morally responsible for an outcome when their action causally contributed to it. Considering the causal relations between our acts and potential good and bad outcomes is also of crucial importance when we plan our future actions. Here, we investigate which aspects of causal relations are particularly influential when the moral permissibility of actions and the moral responsibility of agents for accidental harms are assessed. Causal strength and causal structure are two independent properties of causal models that may affect moral judgments. We investigated whether the length of a causal chain between acts and accidental harms, a structural feature of causal relations, affects people's moral evaluation of action and agent. In three studies ($N = 2285$), using a combination of vignettes and causal learning paradigms, we found that longer chains lead to more lenient moral evaluations of actions and agents. Moreover, we show that the reason for this finding is that harms are perceived to be less likely, and therefore less foreseeable for agents, when the relation is indirect rather than direct. When harms are considered equally likely and equally foreseeable, causal structure largely ceases to affect moral judgments. The findings demonstrate a tight coupling between causal representations, mental state inferences, and moral judgments, and show that reasoners process and integrate these components in a largely rational manner.

1. Introduction

Morality and causation are deeply intertwined. For instance, we typically only hold agents accountable for outcomes they have presumably caused. Considering the potential consequences of actions is also of crucial importance *before* these actions are performed. As such, we may criticise our friends' decision to smoke, eat meat, or not get vaccinated by pointing to potential harms that their actions may cause. For many practical purposes, saying that someone "caused" some unwanted outcome is equivalent to saying that they are to blame for it (Livengood & Sytsma, 2020; Samland & Waldmann, 2016; Schwenkler & Sievers, 2022). And even when we clearly are not at fault (e.g., for lack of relevant knowledge or control), we usually cannot help but feel guilt when we harm others. An extreme example are cases of people who caused severe injury or even death to others accidentally and blamelessly, but nevertheless feel guilty, sometimes for the rest of their lives (Anderson et al., 2021).

Considering causal relations in moral judgments feels spontaneous, casual, and natural to us. However, this type of reasoning is a product of sophisticated cognitive operations. Condemning an action because of its negative consequences requires an understanding of the fact that the action *causes* these consequences, and is not merely statistically associated with them. Moreover, we would naturally consider how *likely* these negative consequences actually are, whether there are alternative causes of the outcomes, and whether there are any additional positive or negative effects. In the meat example, a friend might argue that they, too, regret the environmental impact of meat consumption, and don't deny that our food habits are causes. However, they may additionally emphasize that the link between their particular choice of meal today and global outcomes is weak, and that there are substantial alternative causes of global warming that should be addressed instead, such as the use of fossil fuels. Finally, they may argue that in light of these considerations, the positive effect of enjoying their meal outweighs the negligible impact on the planet. If we argue back, we will probably cite different causal relations to change their minds, such as the claim that one person going vegan inspires others, and that the behavior of a large number of people may have an impact on global outcomes after all. How we acquire and confidently use such causal knowledge is by no means a

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https://doi.org/10.1016/j.cognition.2022.105167
Received 4 January 2022; Received in revised form 17 April 2022; Accepted 10 May 2022
Available online 31 May 2022

trivial question (see, e.g., Gopnik & Schulz, 2007; Waldmann, 2017).

1.1. How causal models support moral reasoning

Causal Bayes Nets provide us with a structured method of describing and studying such and similar inferences within causal models. They have their origins in computer science and Artificial Intelligence (Pearl, 2000; Pearl & Mackenzie, 2019; Spirtes et al., 1993), but are currently also one of the most successful theories of human causal reasoning (Waldmann, 2017; Sloman, 2005; Rottman and Hastie, 2014). They have two crucial dimensions, *causal structure* and *causal strength*. Causal structure describes, simply put, what causes what. The causal relata are conceptualised as variables, which can either be binary or continuous. A binary variable takes on a value of one when a particular event occurs (e.g., our friend is mad at us), and a value of zero otherwise (our friend is not mad at us). Causal models are often depicted as graphs, with nodes representing cause and effect variables, and arrows representing the directed causal relationships between them. Fig. 1 shows three simple examples of causal structures. One cause can have several effects (common-cause structure), one effect can have several causes (common-effect structure), or several causes can be lined up in a row, each being its predecessors effect (causal chains). Causal structure thus represents important *qualitative* causal knowledge. We can learn about causal structures by observing statistical regularities in our environment (Cheng, 1997; Griffiths & Tenenbaum, 2005; Meder et al., 2014), or by explicit instruction (e.g., reading a textbook or a study, or by asking questions, see Hagmayer & Engelmann, 2020).

The second crucial dimension of causal models is *causal strength*. Causal strength parameters express how strong the causal relationship between two directly linked variables within a network is. In the Causal Bayes Nets framework, this strength is conceptualised as probabilistic dependence. That is, saying that A directly causes B expresses that the presence of A increases or reduces the probability of B. How exactly causal strength is best measured is debated (Perales et al., 2017). A simple way to estimate causal strength is to observe how often B occurs when A has occurred, and subtract how often B occurs when A is absent. This measure is known as a contingency, or as Δ-*p*, a difference between two conditional probabilities (Cheng & Novick, 1990, 1991). Cheng (1997) proposed a modified measure in her Power PC theory, which expresses causal strength as the probability of an effect in the presence of the cause in the hypothetical absence of all alternative causes. Whenever an effect has just one cause, the strength of the link between them can simply be estimated by p(effect|cause) (a simple conditional probability), in both the Δp and the Power PC accounts.

A further feature of causal models is that they encode assumptions about conditional independence (Markov condition). In a three-variable chain, for example, the default assumption is that the initial cause covaries with the final effect but becomes statistically independent once the mediating variable is held constant (see for example Mayrhofer & Waldmann, 2015). Assuming the validity of the Markov condition allows us to make inferences about indirect probabilistic relations. For example, in a causal chain with three variables, the two link strengths can be used to calculate the indirect strength between the initial and the terminal variable.

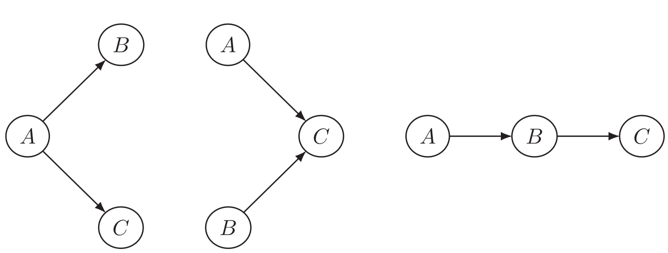

Fig. 1. Examples for different causal structures: a common-cause structure (left), a common-effect structure (middle), and a causal chain (right).

There are several ways in which we can learn about probabilities, and thereby about causal strength. Probabilities can be explicitly stated, like when we learn about a medication's possible side effects by reading the packaging. In other cases we learn via direct interaction with our environment, for instance when we track how our friends tend to react to different behaviours of ours. The former is known as "learning by description" and the latter as "learning by experience" (Hertwig et al., 2004, 2018). Description and experience formats can also be mixed. Both formats can be used to convey quantitative information.

Equipped with knowledge about causal structure and causal strength, we can make a variety of inferences that are crucial for moral judgments (Sloman et al., 2009; Waldmann et al., 2017; Waldmann & Wiegmann, 2012). Generic causal knowledge, that is, knowledge about which causal relations generally exist in the world (structure knowledge) allows us to tentatively predict outcomes that matter to us, both on a generic level (e.g., "does smoking cause cancer?") as well as in singular cases ("will Peter's smoking cause him to get cancer?"). However, additional knowledge about strength allows us to make more specific quantitative estimates. Both structure and strength are relevant for prospective moral judgments, that is, when we gauge the morality of an action prior to knowing which of its possible consequences will actually occur. Structure knowledge is important because it tells us which effects we, and the person contemplating the act, can and should anticipate. An agent who knowingly puts others at risk will be evaluated negatively in most cases. Strength information may be an additional factor affecting the degree of an action's permissibility. If we learn that the causal relationship between action and harm is only weak, we will likely see the action as more permissible than when the relationship is strong.

Causal models not only enable predictive judgments, they also allow us to think backwards, and consider the causes of events that have already happened (Meder & Mayrhofer, 2017). For instance, we may conclude that someone who caused an accident may have been intoxicated. In other cases, we might observe a potential cause and an effect in a specific case, and wonder whether the potential cause actually produced the effect in this case, or whether it was only a co-incidence that both were present. For example, someone who took a drug that can affect alertness may have been involved in an accident, but in this particular case the drug may not have causally contributed to the accident. Such questions, which are about singular causation (Cheng & Novick, 2005; Stephan & Waldmann, 2018), are highly relevant because holding someone responsible for some outcome generally requires that their action caused it (Alicke, 2000; Driver, 2008; Rudy-Hiller, 2018).

It is generally acknowledged that causal reasoning matters for moral judgments (Lagnado & Gerstenberg, 2017; Sloman, Fernbach, & Ewing, 2009; Waldmann, Wiegmann, & Nagel, 2017). For instance, people's moral judgments are sensitive to whether or not there was a causal connection between someone's action and harm to another person (Cushman, 2008), analyzing the causal structures of moral dilemmas can explain moral inferences (Waldmann et al., 2017; Wiegmann & Waldmann, 2014), and counterfactual inferences on causal models determine how we allocate responsibility in group settings (Zultan et al., 2012). Nevertheless, the interplay between the two dimensions of causal models, causal structure and causal strength, has not yet been systematically investigated in the context of moral reasoning. The aim of this article is to start filling this gap, focusing on the case of causal chains.

1.2. Causal chains and moral judgment

In a causal chain consisting of the variables A, B, and C, A may directly cause B, and B may cause C (see Fig. 1). While three variables are minimally required, causal chains can of course also be longer. Chains are a particularly interesting starting point for our project because the interaction between causal structure and causal strength seems very likely in moral judgments about chains, and has in fact been stipulated, but not yet investigated (see Sloman et al., 2009). To illustrate, consider a case in which one person's action has a risk of causing harm to another. For instance, a doctor may consider which of two medications to administer to an unconscious patient in an emergency. Assume that both drugs would fulfill their main purpose, saving the patient's life, equally well. However, both can also cause chronic dizziness as an unwanted side effect. Say that for drug A, the doctor remembers that the drug sometimes causes dizziness directly. For drug B, on the other hand, the doctor recalls that the drug sometimes causes patients to feel more energized than usual after their recovery, which in turn sometimes leads to increased levels of physical activity. Because of the higher physical activity, patients' iron levels can sometimes become depleted, which, finally, sometimes leads to a chronic feeling of dizziness. In sum, whereas drug A leads to the negative side effect directly, drug B leads to the same side effect through a relatively long chain of events. Fig. 2 illustrates the two different causal structures that are involved in this example. Does it seem better to prescribe drug B rather than drug A? And if the patient actually suffers from chronic dizziness after their recovery, is the doctor who prescribed drug A (direct relation) more blameworthy or morally responsible than the doctor who prescribed drug B (indirect relation)? If so, why?

While the difference between the causal structures mediating the side effect (direct vs. chain) may be the most salient difference in the example, the case also touches upon intuitions about causal strength, by using probabilistic expressions such as "sometimes causes". By featuring multiple probabilistic links, the overall relationship between the initial action (prescribing the medicine) and the final outcome (chronic dizziness) may appear to be weaker in the causal chain compared to the direct relation (which includes just one probabilistic link). If all links have equal strengths, and the chain honors the Markov condition, a lower probability of the dizziness given the medication is indeed formally entailed (see Stephan et al., 2021). However, the overall relation between medication and dizziness can also be equally strong in the chain as in the direct relation if the individuals links in the chain are sufficiently strong.

In our experiments, we will investigate whether actions that can cause harm to another person are seen as more morally permissible in chains compared to direct relations. We will also investigate whether agents are viewed as less morally responsible for harms that were brought about via a chain of events, as compared to a direct relation. If we actually find more lenient moral judgments in the chain conditions, there are two prominent candidate explanations for them, and both have their roots in the underlying causal representation of the situation.

1.2.1. *The probabilistic model*

One possibility is that effects of causal structure (chains vs. direct relations) on moral judgments are ultimately driven by inferences about causal strength. On this view, actions and agents are evaluated more favourably in chains because people take harms to be less likely, compared to direct relations. If harm is less likely to result from an action, it makes intuitive sense that the action should be seen as more permissible in a prospective moral evaluation. But why would the a priori likelihood of harm matter in a *retrospective* assessment of moral responsibility? After all, it is already known that harm has occurred at this stage. One reason could be that retrospective judgments may be

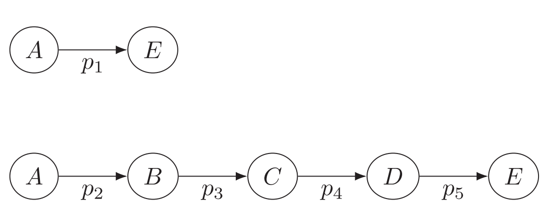

Fig. 2. Illustration of a direct causal relation (top) and a longer causal chain (bottom). p's stand for the strengths of causal links.

influenced by singular causation judgments. These judgments assess whether a present potential cause and a present effect are indeed causally related in a particular situation, or whether their co-occurrence is merely a coincidence. Research on singular causation judgments has demonstrated that causal strength influences these inferences (Stephan & Waldmann, 2018). Everything else equal, stronger causes are more likely to have caused an outcome than weaker causes. If people are less confident that an action actually caused the harm in question, it makes sense that they would hold the agent less morally responsible. Another important reason might be reduced a priori foreseeability of the outcome on the part of the agent (see 1.3).

There is evidence that people actually tend to infer a weaker overall relation in causal chains compared to direct relations (Bes et al., 2012; Stephan et al., 2021). As pointed out earlier, whether this inference is normatively justified or not depends on the assumed strengths of the causal links in the different conditions. In Fig. 2, if all individual causal links p_1 - p_5 have roughly the same probabilistic strength, and the chain honors the Markov condition, it is analytically true that the direct effect has a higher probability than the indirect effect. This is true because in Markov chains the strength of the relation between the initial cause and the final effect can be calculated by multiplying the strengths (measured as Δp) of all mediating links (Stephan et al., 2021). Thus, if all links had a strength of 0.7, the overall strength of the relation between action and harm in the direct relation in Fig. 2 would also be 0.7, but it would be 0.7^4 in the chain. Verbal cues such as "sometimes causes" probably convey to participants that all links are probabilistic and roughly equally strong (Meder & Mayrhofer, 2017). When all links are deterministic (strength $= 1$, which is almost never the case in real-world scenarios), or when no information about link strength is available at all (which means that the overall relation could be weaker, stronger, or equally strong in chains compared to direct relations), weakening is not normative.

The probabilistic model thus predicts that more positive moral evaluations of action and agent in chains compared to direct relations should be observed because participants often infer that harm is less likely in chains. When reasoners know that the overall relation between action and harm is just as strong in chains as in direct relations, no effect on moral judgments is expected.

1.2.2. *The indirectness model*

Another possibility is that causal structure itself drives effects of chain length on moral judgments because chains make the harm appear more indirect, independent of its likelihood. Royzman & Baron (2002) demonstrated that people regard indirect harm as morally better than direct harm across a range of scenarios featuring different kinds of indirectness (for a replication, see Ziano et al., 2021). People also considered harm to be less likely to be caused when the relation was indirect rather than direct. However, these studies did not investigate whether the better moral evaluation was due to the lower probability of harm being caused, or whether both are separate effects of indirectness. Psychologically, effects of indirectness itself might be explained by Construal Level Theory (Trope & Liberman, 2010). According to this theory, different kinds of distance (spatial, temporal, social, hypothetical or counterfactual worlds, etc.) are represented as one unified dimension of "psychological distance" in our minds (but see Calderon, Mac Giolla, Ask, & Granhag, 2020; Žeželj & Jokić, 2014; Maier et al., 2022). Increasing psychological distance in any way is predicted to have similar downstream effects on a range of judgments and decisions.

The indirectness model predicts that actions and agents should be evaluated more positively in chains than in direct relations, even when the probabilistic relationship between action and harm is known to be equally strong in both cases. In other words, the indirectness model assumes that there is a genuine effect of causal structure on moral judgments, independent of causal strength.

1.3. The role of foreseeability

To be held morally responsible for a harmful outcome, agents are generally not just required to have caused the outcome. It also has to be reasonably foreseeable to them that the harmful outcome might be produced by their actions. This requirement is reflected in the so-called *epistemic condition* in philosophical theories of moral responsibility (Rudy-Hiller, 2018), and in definitions of negligent or reckless behaviour in the law (see, e.g., Dubber, 2015, *pp*. 42–46). There is robust evidence that foreseeability plays a crucial role in the judgments of laypeople as well, be they about permissibility (Cushman, 2008, 2013; Paharia et al., 2009), blame (Alicke, 2000; Fincham & Jaspars, 1983; Lagnado & Channon, 2008; Samland & Waldmann, 2016), punishment (Cushman, 2008, 2013), liability (Johnson & Drobny, 1985), or agent causation (Alicke, 2000; Fincham & Jaspars, 1983; Kirfel & Lagnado, 2021; Lagnado & Channon, 2008).

We therefore expect that inferences about foreseeability are a crucial mediator between causal models and moral judgments. Generally, we predict that people are held less accountable for harmful outcomes the less they were able to foresee the outcome. Prospectively, actions should become more permissible the less an agent can foresee it to produce harmful consequences. For the comparison between direct relations and chains, we predict that if agents and actions are evaluated more positively in chains, this will be because people take agents to be less able to foresee the actual occurrence of harm, compared to direct relations. This hypothesis is compatible with both the probabilistic model and the indirectness model. Under the probabilistic model, harm may seem less foreseeable because it becomes less likely. Under the indirectness model, harm may seem less foreseeable because of the indirect relation between action and outcome. Different levels of foreseeability between chains and direct relations only arise when agents in both cases are *aware* of the respective causal relation between their action and some harmful outcome. We thus predict that chain length will only affect moral judgments when agents know that and how their action is connected to a harmful outcome. Conversely, when harm is taken to be equally foreseeable or unforeseeable in chains and direct relations, we predict no difference in moral evaluations.

1.4. Previous work on causal chains and moral judgment

Causal chains have long been of interest to psychologists, philosophers, and legal scholars alike (Hart & Honoré, 1985; Hilton et al., 2010; Knobe & Shapiro, 2021; Livengood & Sytsma, 2020; Spellman, 1997). However, a popular research question has been how people *select* “the” (main, most important, proximate, or legal) cause of an outcome from a sequence of events that led to the outcome in question. For example, if one person shoots a gun at another, and this second person, while fleeing from the gunshots, accidentally pushes a bystander into oncoming traffic, should the shooter be liable for the bystander's death (*cf.* Pearl & Mackenzie, 2019, *p*. 288)? Or does the pushing by the fleeing man supersede the initial action, and should therefore be regarded as the cause of death? The answers that people give about such or similar cases have been shown to depend on the cause's position in the chain, its probabilistic relation to subsequent events and to the final outcome, or whether the cause is an intentional action or merely a physical event (Hilton et al., 2010; Lagnado & Channon, 2008; McClure et al., 2007; Spellman, 1997). In any case, determining the main, proximate, or legal cause of an outcome comes down to comparing different events *within* a chain, and then designating the most important one as the cause.

In contrast to this line of research, the cases that we are focusing on here are not selection tasks. In the doctor example, prescribing the medication is arguably the main cause of patients experiencing dizziness, in the chain version as well as in the direct version of the case. However, we are going to *vary* the actions' proximity to outcomes within the causal model representation, construing the relation as direct or as indirect. This amounts to a comparison *between* two possible ways in which the same action and outcome could be related. We are interested in a level of causal reasoning that is more fundamental than causal selection (see also Samland & Waldmann, 2016). Before a cause can be selected from a chain, people have to arrive at a cognitive representation of the cause's relation to other events of interest.

To our knowledge, only one study has so far compared chains of different length while holding the initial action and the final outcome constant. Johnson & Drobny, 1985 presented their participants with two versions of a case in which a truck driver forgets to replace a safety pin in his truck after an inspection. In either case, the steering fails as a result, and an accident occurs. In the “short chain” condition, the accident causes a fire, and the fire burns down a nearby house. In the “long chain” conditions, the fire ignites some gasoline, which flows down a hill and across a river, sets fire to grass on the other side, which finally also causes a house to burn down. Participants indicated that the driver was equally negligent in both conditions, but that he was less able to foresee the damage to the house in the long compared to the short chain condition. They also judged the driver to be less liable for the damage in the long chain condition. These findings thus provide initial evidence for an effect of causal structure. However, Johnson & Drobny, 1985 did not investigate the cognitive mechanism behind their findings. Is the driver less liable because he was less able to foresee harm? Was he less able to foresee harm because it became increasingly unlikely to be caused by his negligent omission in the longer chain? Moreover, their experiment confounds causal structure with the type of chain events. The short chain consists of saliently different events than the long chain. We control for this confound by comparing chains and direct relations that could, in principle, be underwritten by the same causal mechanism at different levels of granularity.

2. Overview of experiments

Experiment 1 set the stage for the project by establishing that actions are seen as more permissible, and agents as less responsible, when actions and harmful outcomes are connected via a chain rather than directly. The experiment also confirmed that this effect depends on the attribution of different levels of outcome foreseeability to agents.

Experiment 2 aimed to test the probabilistic model and the indirectness model against each other by crossing causal strength and causal structure. Participants learned about the strength of the overall relations between initial actions and final negative outcomes. The same contingency data linking these two types of events were presented for chains and direct relations. The results confirmed predictions of the probabilistic model, but relations were not yet perceived as equally strong in chains and direct relations. Thus, there were still some findings that are compatible with both models.

In Experiment 3, the number of observations for the contingency learning task was increased to improve learning. The results now showed that chains and direct relations were perceived as equally strong. The results for moral judgments generally supported the probabilistic model. There was also some evidence that structure itself matters, which is predicted by the indirectness model. However, effects of structure alone were small and not consistently detected. Experiment 3 also explored foreseeability in a more fine-grained manner.

The materials, data, and analysis code for all experiments (as well as additional analyses and figures) are available at https://osf.io/5bmgc/(from here on: Supplementary Materials). For all analyses and figures, we used R (Core Team, 2020) and RStudio (RStudio Team, 2020) in combination with the following packages (in alphabetical order): ***effsize*** (Torchiano, 2020), ***ez*** (Lawrence, 2016), ***ggpubr*** (Kassambara, 2020), ***Hmisc*** (Harrell, 2020), ***lavaan*** (Rosseel, 2012), ***lmtest*** (Zeileis & Hothorn, 2002), ***MASS*** (Venables & Ripley, 2002), ***MBESS*** (Kelley, 2020), ***mediation*** (Tingley et al., 2014), ***meta*** (Balduzzi et al., 2019), ***nlme*** (Pinheiro et al., 2020), ***rcompanion*** (Mangiafico, 2021), ***reshape2*** (Wickham, 2007), ***tidyverse*** (Wickham et al., 2019), ***xtable*** (Dahl et al., 2019).

3. Experiment 1: Causal structure and outcome foreseeability

The aim of this experiment was to test whether the representation of a causal chain between an action and a harmful final outcome would lead to a more positive moral evaluation of the action or the agent than the representation of action and outcome as being directly linked. Furthermore, we tested whether these effects are mediated by attributions of outcome foreseeability to agents. Both the probabilistic model and the indirectness model predict that agents in chains are evaluated more leniently because people take them to be less able to foresee harm, compared to agents confronted with direct relations. Chains only lead to less foreseeability than direct relations when agents know about the respective causal relation between their action and harm. We thus vary agents' knowledge, and predict that there will only be a moral difference between chains and direct relations when agents know about the relations. When they are unaware, there should be no difference between these two types of causal structure.

The results of this experiment will not distinguish between the probabilistic model and the indirectness model. Both models predict an effect of causal structure and the described interaction with foreseeability, albeit for different reasons. Experiments 2 and 3 will implement more focused tests. However, we will assess whether overall relations are perceived as weaker in chains than in direct relations. Such an effect would be a necessary prerequisite for the validity of the probabilistic model.

We manipulated causal structure (direct relations vs. chains) and the awareness of agents of the relation between their action and the potential harmful outcome (knowledge vs. no knowledge). Participants were asked for a prospective moral evaluation of permissibility ("is it okay to act?"), and for a retrospective evaluation of agents' moral responsibility for the harms caused.

3.1. Methods

3.1.1. Design and participants

We used a 2 (structure: *direct* vs. *chain*, within-subject) x 2 (knowledge about the causal relation: *knowledge* vs. *no knowledge*, between-subjects) design. We created three cover stories, which were combined with the two levels of the structure manipulation in a Latin Square design, such that each participant saw the *direct* case in a different cover story than the *chain* case. This design resulted in six unique combinations of cover story and relation. Participants were randomly assigned to one of those combinations. The sample size was determined by simulation (see Supplementary Material for the code). Based on pilot studies we assumed an effect of $d = 0.22$ for moral permissibility ratings and an effect of $d = 0.30$ for moral responsibility ratings in the *knowledge* conditions. We predicted null effects on both measures in the *no knowledge* conditions. With a sample size of at least 700 participants, we were able to detect a) the predicted effects on moral judgments in separate, one-sided t-tests as well as b) the predicted interaction between causal structure and knowledge in a 2×2 ANOVA with a power of $>$90% for each measure (combined power for both measures and all predicted effects: 87%). 726 participants completed the survey. After applying the exclusion criteria, data of 704 participants remained for all analyses ($M_{age} = 34.81$, $SD_{age} = 13.14$, 353 women, 343 men, 7 non-binary, 1 no answer).

3.1.2. Materials and procedure

The experiment began with information about the generic causal relationship between an action and a harmful outcome. One of the three cover stories, here shown in the *chain* version, for example, read (see Supplementary Material for the other stories):

> A group of scientists is investigating the effects of exposure to a certain chemical called Proskine. In their studies, they found the following results:
>
> - When Proskine is produced and stored, this sometimes causes changes in the PH level within a storage container.
> - When these changes occur, it sometimes causes Xaligene gas to develop in the container.
> - When Xaligene gas is present in a container, this sometimes causes condensation.
> - When this condensation occurs, it sometimes causes another chemical called Yosium to form in the container.
> - When Yosium is present, it sometimes causes certain proteins to be blocked in the human body (for people in the vicinity).
> - When these proteins are blocked, it sometimes causes Vanine, a transmitter substance, to build up.
> - When Vanine has built up, this sometimes causes a deficiency of a molecule called Alpha 3.
> - When there is an Alpha 3 deficiency, it sometimes causes some tissue irritation in the lung.
> - When this tissue irritation occurs, it sometimes causes Marasia illness, a severe respiratory condition.

Please take a moment to study and understand the illustration.

In the *direct* condition, just one link was described ("When Proskine is produced and stored, this sometimes causes people in its vicinity to get Marasia illness, a severe respiratory condition"). Fig. 3 shows an example of the illustrations that were used in each condition. We decided to use relatively long chains because previous experiments have shown that a substantial reduction in predictive causal judgments is needed to affect moral judgments (Engelmann & Waldmann, 2021). The nodes connecting action and outcome were physical or biochemical events in all stories. We kept the material artificial to preclude knowledge or any strong assumptions about the strength of the causal links between them. After participants had learned about the generic causal relation, they were presented with the case of an agent who was about to perform the harmful action. In the *knowledge* conditions, we pointed out that the agent was aware of the causal relation that participants had just learned about:

> In a pharmaceutical lab, the chemist Mary produces and stores some Proskine, which she needs for her research. The lab is shared with several colleagues.
> Since the scientists studying Proskine have published their results, she is aware of the previously described findings.

In the *no knowledge* conditions, we stated:

> Since the scientists studying Proskine have not published their results so far, Mary cannot be aware of them. To the best of her knowledge, there are no special risks associated with producing and storing Proskine.

We asked participants: "From a moral point of view, is it okay for Mary to produce and store Proskine?" Ratings were provided on a 10-point scale ranging from "not at all" to "fully". On the next page, we informed participants that the harmful outcome had actually occurred ("It later turns out that Mary's colleague Andrew contracted Marasia illness") and asked them to assess the agent's moral responsibility ("To what extent is Mary morally responsible for Andrew contracting Marasia illness?", using the same scale). After participants had morally evaluated two scenarios in this way (one with a direct relation and one with a chain), both scenarios were presented anew and we asked participants for a predictive causal judgment ("Given that Proskine is produced and stored, how likely is it for a person close by to develop Marasia illness?", from 0-100%). We also asked them to rate the agents' ability to foresee the harm ("To what extent could Mary foresee that someone would be harmed by her action?", 10-point scale from "not at all" to "fully"). The experiment ended with a debriefing and the assessment of demographic variables.

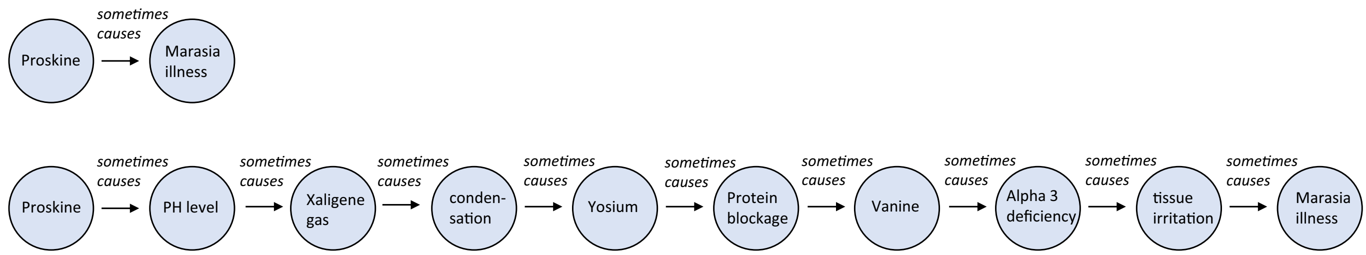

Fig. 3. Example illustrations of a direct relation (top) and the corresponding chain (bottom) in Experiment 1.

3.2. Results and discussion

Fig. 4 provides an overview of the results, and Table 1 shows the descriptive statistics for all conditions. As predicted, actions were seen as more permissible in the chain conditions than in the direct relation conditions, but only when agents were aware of the relation between their action and the harmful outcome (see Table 2 for the results of the planned *t*-tests for both moral judgment questions, and Table 3 for the results of ANOVAs for all measures). Participants also judged agents to be less morally responsible for the harm caused by their actions in the chain conditions. Against our predictions, the effect of structure on responsibility judgments did not entirely disappear in the no knowledge conditions, but the remaining effect was very small there (see Table 2). Thus, we showed that causal chains lead to a more lenient moral evaluation of actions and agents than direct causal relations, and that this effect is largely mediated by attributions of outcome foreseeability.

While participants always perceived outcomes as less likely to be caused in chains than in direct relations, this weaker causal relationship only led to lowered attributions of outcome foreseeability when agents were aware of the respective relations (see Fig. 4, Table 3). Without such knowledge, harm was generally taken to be unforeseeable, actions as permissible, and agents as not morally responsible, no matter the causal structure.

Table 10 in the Appendix shows the correlations between all measures in this experiment (put briefly, permissibility ratings are negatively correlated with all other measures, while all other measures are positively correlated). See Supplementary Materials for additional mediation analyses and for a figure showing participants' response trajectories across the different measures.

The results of the experiment are in line with the probabilistic model, but they cannot rule out the indirectness model either. After all, reasoners might always perceive harms as less foreseeable in chains, even when causal strength is equally high as in a direct relation. The probabilistic model, on the other hand, assumes that outcomes only become less foreseeable because they are perceived as less likely. For a more thorough investigation of the mediating role of predictive causal judgments, we are going to vary both causal structure and causal strength in the subsequent experiments.

4. Experiment 2: Causal structure and causal strength

In this experiment we crossed the structure by which actions and outcomes are related (chains vs. direct relations) with the strength of the overall relation between action and outcome (weak vs. strong). The probabilistic model predicts that causal structure should cease to affect foreseeability, and thereby moral judgments, when the overall relation between action and outcome is equally strong in chains and in direct relations. Attributions of outcome foreseeability and moral judgments should only be affected by strength on this view. Low strength should lead to less foreseeability, and a more positive moral evaluation of action and agent, compared to high strength. The indirectness model, on the other hand, predicts that causal structure still affects outcome foreseeability and moral judgments (less foreseeability and more positive moral evaluation in chains) when relations are perceived to be equally strong.

We also added a singular causation question to our procedure in this experiment. That is, we retrospectively asked participants how confident they were that the action actually caused the harmful outcome in this situation. Singular causation is generally seen as a prerequisite for assigning moral responsibility (see, e.g., Driver, 2008; Rudy-Hiller, 2018). Thus, an additional reason why moral responsibility is lower in chains than in direct relations (apart from lower outcome foreseeability) could be that participants are less confident that agents actually have caused the harmful outcomes in chains.

Just as causal strength, confidence in singular causation depends on how often reasoners observe an effect in the *presence* of its putative cause, as well as in its *absence* (Cheng & Novick, 2005; Stephan & Waldmann, 2018). We aimed to control both of these probabilities in our experiment (manipulating p(outcome|action), and keeping p(outcome|¬action) fixed at zero) to better control what subjects assume about the observed causal relations. We decided to present these conditional probabilities in a trial-by-trial observational learning task (see Stephan et al., 2021, for a similar paradigm). That is, participants repeatedly observed whether cause and effect were present or absent in particular cases.

4.1. Methods

4.1.1. Design and participants

We employed a 2 (strength: p(outcome|action) =.80 vs. p(outcome|action) =.20) x 2 (structure: *direct* vs. *chain*) x 3 (cover story: *apples* vs. *chemical* vs. *computer*) design. In all conditions p(outcome|no action) was zero. All factors were manipulated between subjects. We collected the same measures as in Experiment 1, but we added a control question about the probability of the effect in the *absence* of the target action (p(outcome|no action)) and the aforementioned question about singular causation. We conducted a power analysis based on meta-analytic effect size estimates (including data of pilot studies) for the effect of causal structure on ratings of moral permissibility ($d = 0.25$ [0.17;0.32]) and moral responsibility ($d = 0.29$ [0.21;0.36], see Supplementary Material for details on the meta analysis and the data of the pilot studies). Based on this analysis we planned to collect data of at least 694 participants in this experiment. With this sample size we were able to detect both effects with 94% power in one-sided paired *t*-tests (Faul et al., 2007).[1] The power analysis focused on the effect of causal structure on the two moral measures because we expected these effects to be the smallest in the design. 727 participants completed the survey. 16 were excluded, leaving data of 711 participants for the analyses ($M_{age} = 36.38$, $SD_{age} = 13.52$, 416 women, 287 men, 6 non-binary, 2 no answer).

4.1.2. Materials and procedure

In each condition participants first learned about the generic causal relation between an action and a harmful outcome (*direct* vs. *chain*) in

[1] For the lower bounds of the meta-analytic 95% confidence intervals ($d = 0.17$ for permissibility and $d = 0.21$ for responsibility), the planned sample size yields a power of 75% and 89%, respectively.

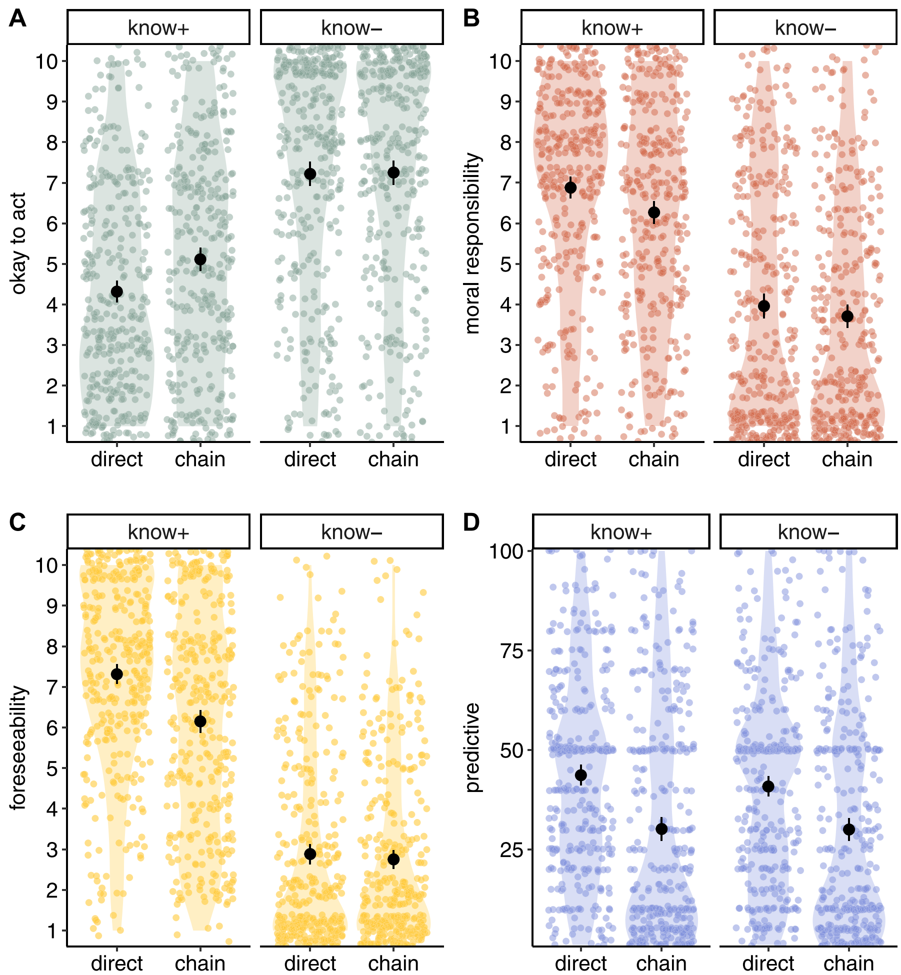

Fig. 4. Means and 95% confidence intervals for ratings of moral permissibility (A), moral responsibility (B), attributions of outcome foreseeability (C), and predictive causal judgments (D) in Experiment 1.

Table 1
Means and standard deviations per condition in Experiment 1.

Condition	Query	Relation	*M*	*SD*	*n*
knowledge	permissibility	direct	4.32	2.56	352
		chain	5.11	2.75	
	responsibility	direct	6.88	2.55	
		chain	6.27	2.69	
	foreseeability	direct	7.31	2.34	
		chain	6.15	2.69	
	predictive	direct	43.63	24.88	
		chain	30.12	28.57	
no knowledge	permissibility	direct	7.22	2.83	352
		chain	7.25	2.83	
	responsibility	direct	3.96	2.91	
		chain	3.70	2.71	
	foreseeability	direct	2.88	2.40	
		chain	2.75	2.20	
	predictive	direct	40.80	24.24	
		chain	29.99	27.20	

Table 2
Results of the planned *t*-tests for effects of causal structure (chains vs. direct relation) on judgments of moral permissibility and moral responsibility in Experiment 1. *P*-values are one-tailed for the knowledge conditions, and two-tailed for the no knowledge conditions (in line with the hypotheses).

Condition	Query	*t(df)*	*p*	*d (95 % CI)*
knowledge	permissibility	−5.08 (351)	<.001	−0.30 (−0.42; −0.18)
	responsibility	3.80 (351)	<.001	0.23 (0.11; 0.35)
no knowledge	permissibility	−0.26 (351)	0.79	−0.01 (−0.10; 0.08)
	responsibility	2.03 (351)	0.04	0.09 (0; 0.18)

the same way as in the previous experiment. Subsequently they were informed that scientists were also reviewing health records of people who were or were not exposed to the substance or item in question. We informed participants that they were going to see 40 of these health records in the form of illustrations. These illustrations were representations of the causal structure, very similar to the depictions of the relation between action and outcome in the structure instruction phase (see Fig. 5). The presence versus absence of causes and effects were indicated by the colors of nodes (yellow: present, grey: absent). In the *chain* conditions we instructed participants that the variables connecting action and outcome were not measured in the study of health records. Thus, it was unknown whether they were present or absent in any single case. Visually, this was represented by depicting them as light-grey nodes with dashed outlines. Arrows were also dashed and light-grey in all conditions. After the illustrations were explained, participants were requested to answer a set of instruction check questions to confirm that they understood the meaning of all elements of the illustrations (see Supplementary Materials). Proceeding to the next part of the experiment was only possible after all check questions had been answered correctly.

The next phase was an observational learning task with 40 trials (see Table 4 for an overview of trials). In both strength conditions

Table 3
Anova results for all measures of Experiment 1. We report 90% CIs for η_p^2 (see Steiger, 2004).

Query	Factor	*F (df)*	*p*	η_p^2 (90% CI)
permissibility	knowledge	194,96 (1,702)	<.001	0.22 (0.17; 0,26)
	structure	16,63 (1,702)	<.001	0.02 (0.01; 0,04)
	knowledge × structure	14,01 (1,702)	<.001	0.02 (0.01; 0,04)
responsibility	knowledge	237.60 (1,702)	<.001	0.25 (0.21; 0.30)
	structure	18.08 (1,702)	<.001	0.03 (0.01; 0.05)
	knowledge × structure	3.11 (1,702)	0.08	0 (NA;0.02)
foreseeability	knowledge	590.96 (1,702)	<.001	0.46 (0.41; 0.49)
	structure	57.96 (1,702)	<.001	0.08 (0.05; 0.11)
	knowledge × structure	36.89 (1,702)	<.001	0.05 (0.03; 0.08)
predictive	knowledge	0.68 (1,702)	0.41	0 (NA;0.01)
	structure	202.56 (1,702)	<.001	0.22 (0.18; 0.27)
	knowledge × structure	2.49 (1,702)	0.1	(NA; 0.01)

participants saw 20 cases in which the cause (the action) was present and 20 cases in which it was absent. In the "high strength" conditions the effect was present in 16 out of the 20 cases in which the cause was present (p(outcome|action) = 0.80). In the "low strength" conditions the effect was only present in 4 out of the 16 cases in which the cause was present (p(outcome|action) =.20). The effect was never present without the cause in either condition (p(outcome|no action) = 0). The order of trials was randomized, and each trial was visible on screen for 4 seconds, followed by a white mask lasting 0.5 seconds. The animation was created in Adobe Animate 2015 and lasted around 02:30 minutes in total (see Supplementary Materials for an example video). Once the learning phase was over, the experiment proceeded exactly as in the previous studies. We presented participants with an agent who was about to perform the action in question, and asked for judgments of moral permissibility and moral responsibility. On the final page, participants were asked to provide a predictive causal judgment; they were asked to estimate p(outcome|no action), to rate the agent's level of outcome foreseeability, and to indicate their confidence in the claim that the action actually caused the harmful outcome in this particular case (singular causation). An example question for p(outcome|no action) is: "How likely is it for a person to get Marasia illness if they have not been exposed to Proskine in any way?" Ratings were provided on a slider ranging from 0 to 100%. The singular causation question asked for instance: "How confident are you that Mary's action of producing and storing Proskine was the cause of Andrew's Marasia illness?" Here, ratings were provided on a 10-point scale ranging from "not at all" to "completely". All other questions and scales were identical to the ones in Experiment 1. Since each participant saw only one cover story in this experiment, no information was repeated on the last page, it only contained the final questions.

4.2. Results and discussion

Fig. 6 provides an overview of the results and Table 5 shows the

Table 4
Learning trials in Experiment 2 per strength condition (p(outcome|action) =.80 vs. p(outcome|action) =.20).

Strength	Action	Harm	Observations
.80	yes	yes	16
	yes	no	4
	no	yes	0
	no	no	20
.20	yes	yes	4
	yes	no	16
	no	yes	0
	no	no	20

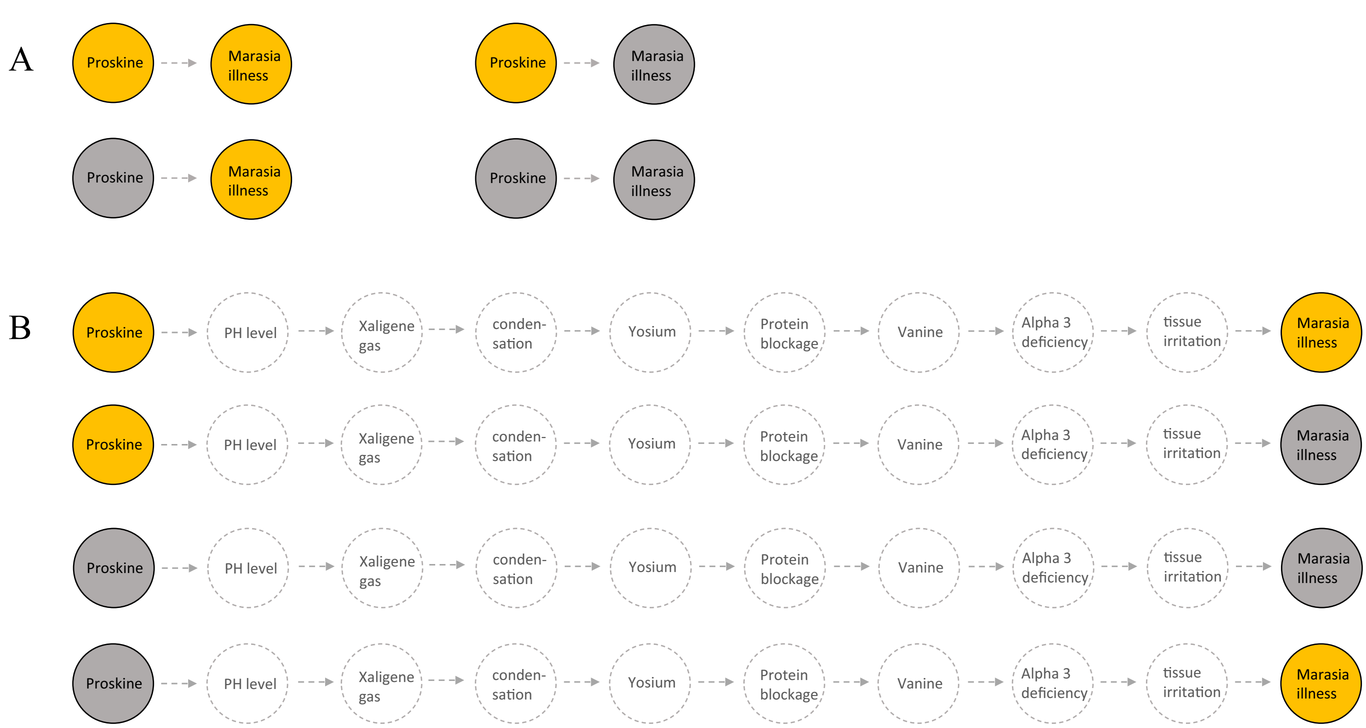

Fig. 5. Example illustrations for direct relations (A) and chains (B) in Experiment 2. Yellow nodes indicated that actions or outcomes were present, grey nodes indicated that they were absent. Dashed circles meant that the status of a variable was unknown.

descriptive statistics for all conditions. Table 6 lists the results of the planned *t*-tests for the effects of causal structure on moral judgments, and, for comparison, also the results of *t*-tests for the effects of causal strength. As expected under the probabilistic model, the causal structure connecting action and harm ceased to affect prospective judgments of moral permissibility in this experiment. Permissibility was low when causal strength was high, no matter whether the causal structure connecting action and harm was a chain or a direct relation. Permissibility was higher when causal strength was low, again independent of causal structure.

Contrary to the predictions of the probabilistic model, a small effect of causal structure persisted for judgments of moral responsibility. Here, agents were still seen as somewhat less responsible in the chain conditions compared to the direct relation conditions[2], even though equal contingencies were presented for both structures. However, this effect was very small. The causal strength manipulation, on the other hand, had clear and distinct effects on judgments of moral permissibility and of moral responsibility in the expected directions (see Table 6), as predicted by the probabilistic model. Participants rated actions as more permissible when they had observed a lower contingency between action and harm, and agents as more responsible when participants had observed a higher contingency.

Table 7 shows the results of exploratory ANOVAs for all remaining measures. As predicted by the probabilistic model, participants considered harm to be less foreseeable by agents when they had learned about a weaker association between action and outcome, but also when action and outcome were connected via a chain rather than directly. The remaining effect of causal structure is not predicted by the probabilistic model. It is consistent with the indirectness model, but there is also an alternative explanation. Looking at participants' predictive causal judgments, we find that despite observing identical contingencies between actions and harmful outcomes, participants still considered the causal relations to be slightly, but significantly weaker in chains than in direct relations (see Fig. 6D, Table 7). This difference might explain the remaining effects of causal structure on foreseeability attributions, and, thereby, on judgments of moral responsibility. When relations are perceived as weaker, the probabilistic model predicts lower outcome foreseeability and a more positive moral evaluation.

Thus, the results are overall consistent with the probabilistic model, although the indirectness model cannot be entirely ruled out yet (based on the effect of causal structure on judgments of moral responsibility). Nevertheless, the evidence for the probabilistic model is clearly stronger than for the indirectness model at this point. The remaining effect of causal structure on moral responsibility ratings was very small ($d = 0.15$ [0.00;0.30]) and only came out significant in some analyses. Plus, this effect lies outside the meta-analytic confidence interval that we determined for this measure based on three preceding studies, in which causal strength was not independently manipulated ($d = 0.29$ [0.21;0.36]). Thus, keeping causal strength constant substantially reduced the effect (and eliminated it entirely for judgments of moral permissibility). Variations in causal strength, on the other hand, had clear and distinct effects on foreseeability and moral judgments in the expected directions.

Why did participants still perceive chains to be weaker than direct relations, even though the objective contingencies were identical? We suspect that learning about a causal chain creates a prior belief about lower causal strength (see also Stephan et al., 2021). Our forty learning trials were apparently only able to partially overwrite this prior. If this explanation is correct, presenting a larger number of observations should lead to the impression of equally strong relations.

Confidence in the fact that actions actually caused the harmful outcomes in the described situations (singular causation) was generally high (see Fig. 6, Table 5), and increased with stronger causal relationships. It was also higher in direct relations than in chains. Participants' estimates of effects occurring in the *absence* of their instructed causes were generally low and not affected by any manipulation. However, they were significantly higher than zero ($M = 10.43$, $SD = 17.10$, $t_{710} = 16.27$, $p < .001$). Since participants thus assumed that alternative causes of our fictitious harmful outcomes existed, the fact that their singular causation ratings increased with the perceived strength of causal relations is in line with normative computational models (Stephan & Waldmann, 2018). Confidence in singular causation correlated with participants' judgments of moral responsibility ($r = 0.55$ [0.50; 0.60], $t_{709} = 17.61$, $p < .001$), as we hypothesized.[3] For further clarification, we predicted responsibility judgments from judgments about singular causation, foreseeability attributions, causal structure, and causal strength in a linear regression. Only singular causation ($\beta = 0.39$, $t_{706} = 10.03$, $p < .001$) and foreseeability ($\beta = 0.34$, $t_{706} = 8.24$, $p < .001$) emerged as significant predictors of moral responsibility judgments in this analysis. Thus, both factors explain unique variance in responsibility judgments. Moreover, causal strength and causal structure cease to predict responsibility when the influence of singular causation and foreseeability is accounted for, providing further evidence for the mediating roles of these latter factors. In the Supplementary Materials, we provide additional mediation analyses and a figure showing participants' response trajectories across the different measures in each condition.

In sum, we set out to test whether causal structure would cease to affect moral judgments when causal strength is kept constant. This is predicted by the probabilistic model, but not by the indirectness model. While we still observed a very small effect of causal structure on one of the moral judgments (moral responsibility) in this experiment, we view the data overall as more in line with the probabilistic model.

5. Experiment 3: Improving learning and exploring foreseeability

This experiment had two aims: First, we substantially increased the number of observations in the causal strength learning phase to facilitate the learning of different causal relations as being equally strong. If participants perceive chains and direct relations as equally strong, the probabilistic model predicts that causal structure should cease to affect moral judgments. Higher strength alone should lead to more severe moral judgments, and lower strength to more lenient judgments, independent of structure. The indirectness model, on the other hand, predicts that chains should still be evaluated more positively than direct relations, even when both are equally strong.

Second, we wanted to explore what exactly agents need to be aware of for their actions to become impermissible, or for them to be seen as morally responsible for harmful outcomes. Given that causal structure and causal strength are separate dimensions of causal models it is possible for agents to be aware *that* a certain causal relation exists between their action and some harmful outcome (i.e., knowledge about structure) but not how strong (or weak) the relation is. Likewise, it is

[2] In line with our *a priori* power analysis (and for a stricter test of our hypothesized null effects), we report the results of one-sided *t*-tests for the effects of causal structure on moral judgments. However, it should be noted that the effect of causal structure on judgments of moral responsibility was *not* significant in a 2 × 2 ANOVA of moral responsibility ratings (see Table 7). Thus, there is only very weak inconsistent evidence for an effect of structure on responsibility judgments independent of strength in this experiment. For judgments of moral permissibility, there was no difference in patterns of significance between ANOVA and *t*-test.

[3] Although there were significant correlations between almost all measures (see Table 11 in the Appendix), the only other measure that was associated with singular causation to a comparable extent as moral responsibility was foreseeability ($r = 0.58$ [0.53; 0.63], $t_{709} = 19.15$, $p < .001$). Fully clarifying the role of singular causation judgments for moral responsibility will require manipulating singular causation independently in future research.

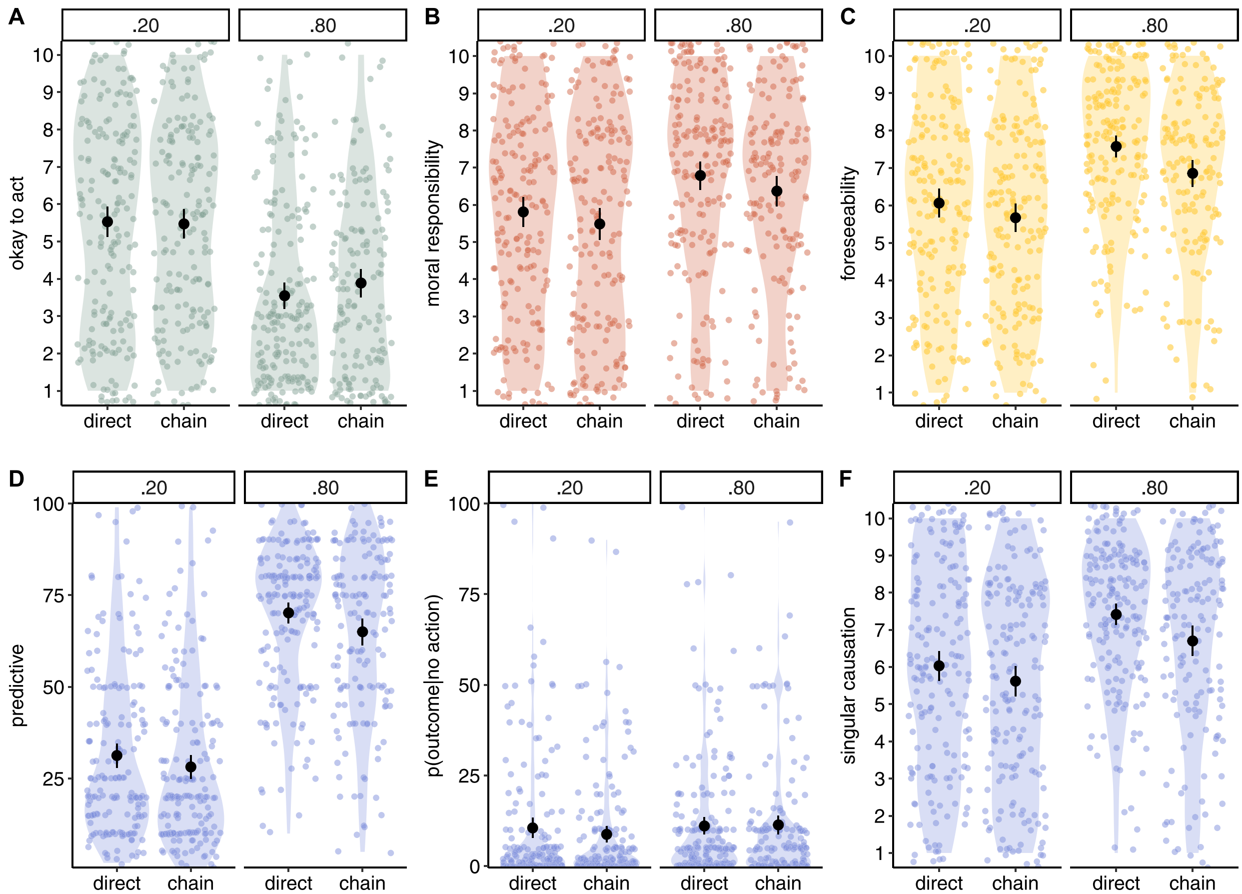

Fig. 6. Means and 95% confidence intervals for ratings of moral permissibility (A), moral responsibility (B), attributions of outcome foreseeability (C), predictive causal judgments (D), p(outcome|no action) (E), and singular causation judgments (F) in Experiment 2.

Table 5
Means and standard deviations per condition in Experiment 2.

Relation	Strength	Query	*M*	*SD*	*n*
direct	.20	permissibility	5.53	2.79	184
		responsibility	5.81	2.73	
		foreseeability	6.07	2.62	
		predictive	31.28	22.69	
		p(outcome|no action)	10.55	19.36	
		singular causation	6.03	2.75	
	.80	permissibility	3.54	2.45	189
		responsibility	6.79	2.64	
		foreseeability	7.58	2.03	
		predictive	70.19	19.53	
		p(outcome|no action)	11.09	16.79	
		singular causation	7.41	1.98	
chain	.20	permissibility	5.47	2.67	181
		responsibility	5.49	2.91	
		foreseeability	5.67	2.58	
		predictive	28.17	22.26	
		p(outcome|no action)	8.78	15.39	
		singular causation	5.62	2.79	
	.80	permissibility	3.89	2.42	157
		responsibility	6.37	2.57	
		foreseeability	6.86	2.26	
		predictive	65.03	23.05	
		p(outcome|no action)	11.39	16.50	
		singular causation	6.70	2.56	

possible to be aware of a probabilistic dependence between action and outcome (i.e., knowledge about strength) without knowing which causal structure underlies the association. Or the agent could be simultaneously aware of both properties of the causal model. While Experiment 1 already established that attributions of outcome foreseeability mediate the effects of causal model representations on moral judgments, the experiment could not differentiate between the influences of structure knowledge and strength knowledge on foreseeability, and thereby on moral judgments.

Table 6
Effects of causal structure (chain vs. direct) and causal strength (high vs. low) on moral judgments in Experiment 2. *P*-values are one-tailed and not adjusted for multiple comparisons.

	Query	*t (df)*	*p*	*d (95% CI)*
causal structure	permissibility	−1.03 (707.17)	0.15	−0.08 (−0.22; 0.07)
	responsibility	1.97 (698.71)	0.02	0.15 (0.0; 0.30)
causal strength	permissibility	−9.29 (706.61)	<.001	−0.70 (−0.85; −0.54)
	responsibility	4.65 (708.6)	<.001	0.35 (0.20; 0.50)

5.1. Methods

5.1.1. Design and participants

We employed a 2 (structure: *direct* vs. *chain*, within-subject) x 2 (strength: p(outcome|action) =.80 vs. p(outcome|action) =.20, between-subjects) x 4 (knowledge: *full knowledge* vs. *no knowledge* vs. *structure knowledge* vs. *strength knowledge*, between-subjects) design. In all conditions p(outcome|no action) was zero. The cover stories were randomly selected for each participant from a set of four stories (*apples* vs. *chemical*

Table 7
ANOVA results per measure in Experiment 2. *P*-values are not adjusted for multiple comparisons.

Query	Factor	*F (df)*	*p*	η_p^2 (90% CI)
permissibility	structure	0.48 (1,707)	0.49	0 (NA;0.01)
	strength	85.11 (1,707)	<.001	0.11 (0.07; 0.14)
	strength × structure	1.04 (1,707)	0.31	0 (NA;0.01)
responsibility	structure	3.27 (1,707)	0.07	0 (NA;0.02)
	strength	20.87 (1,707)	<.001	0.03 (0.01; 0.05)
	strength × structure	0.05 (1,707)	0.82	0 (NA;0.0)
foreseeability	structure	9.36 (1,707)	0.002	0.01 (0; 0.03)
	strength	57.29 (1,707)	<.001	0.07 (0.05; 0.11)
	strength × structure	0.82 (1,707)	0.36	0 (NA;0.01)
predictive causal judgment	structure	6.23 (1,707)	0.013	0.01 (0; 0.02)
	strength	533.78 (1,707)	<.001	0.43 (0.39; 0.47)
	strength × structure	0.39 (1,707)	0.53	0 (NA;0.01)
singular causation	structure	8.59 (1,707)	0.003	0.01 (0; 0.03)
	strength	42.33 (1,707)	<.001	0.06 (0.03; 0.09)
	strength × structure	0.61 (1,707)	0.43	0 (NA;0.01)
p(outcome | no action)	structure	0.36 (1,707)	0.55	0 (NA;0.01)
	strength	1.39 (1,707)	0.24	0 (NA;0.01)
	strength × structure	0.65 (1,707)	0.42	0 (NA;0.01)

vs. *computer* vs. *varnish*) with the constraint that the *direct* and *chain* conditions would be presented in different cover stories for each participant. All measures were identical to the ones in Experiment 2. We decided to collect at least 200 valid responses for each level of the knowledge manipulation (and thus at least 800 valid responses in total). With this sample size we were able to detect an effect of the structure manipulation (*direct* vs. *chain*) on moral judgments of $d = 0.18$ with 80% power in a one-tailed *t*-test in each knowledge condition (Faul et al., 2007). The same test yields a power of 97% for an effect of $d = 0.25$, and we were thus able to detect such an effect in *all* of the eight one-tailed t-tests (four knowledge conditions, two moral judgment measures) with a power of $0.97^8 = 78\%$. Our best estimate for an effect of causal structure in the face of equal causal strength comes from Experiment 2 and is $d = 0.15$ with a 95% confidence interval ranging from 0 to 0.30. We expected causal structure to be the smallest effect of interest in the design, and focused our power analysis on the moral judgment measures. 1165 participants completed the experiment. Eight participants were excluded from the analyses for taking the survey twice (only their first participation was retained), 57 were excluded for either using a smartphone against instructions or for failing the simple attention check. Of the remaining 1100 participants, we excluded those who failed to give correct answers to a manipulation check question about the agents' knowledge in at least one of the scenarios (see next section for the questions). The accuracy of the answers to these test questions ranged from 76% in the *structure knowledge* condition to 96% in the *no knowledge* condition. The final sample consisted of 854 participants ($M_{age} = 32.21$, $SD_{age} = 11.1$, 422 women, 417 men, 14 non-binary, 1 no answer).

5.1.2. Materials and procedure

As in the previous experiments, this experiment also began with the instruction of a generic causal relation between an action and a harmful outcome. This relation could either be direct or a long chain (9 links). The same cover stories as in the previous experiments were used, plus one new story (*varnish*, see Supplementary Materials). In the present experiment, we removed the "sometimes causes" labels from the illustrations. In the verbal description of the causal relations, we also removed this expression and said instead "there is a causal relation between [cause] and [effect]". We decided to do this because we wanted to find out whether an effect of causal structure on moral judgments would persist even when the probabilistic nature of the causal relations and the similarity of the strengths of individual links in the direct and chain relations were not highlighted. In our previous experiments, it was reasonable for participants to form an initial belief that the overall strength in the chain conditions is lower than in the conditions that instructed direct relations.

After the instruction of the generic causal relation, we informed participants that they would now be presented with the results of a second study in which scientists had reviewed health records. Other than in the previous experiment, the data were presented in summary format (see Fig. 7). The presence of a blue circle meant that the target action was present (e.g., someone in a lab had produced and stored the potentially harmful chemical), and a red person icon meant that the harmful outcome had occurred (e.g., the person had developed the disease). The summary format allowed us to present participants with three times as many observations as in the previous experiment (120 instead of 40), while keeping the experiment at a reasonable length. Before participants were able to see the data, they had to correctly answer two instruction check questions to confirm that they understood the meaning of the symbols (see Supplementary Materials).

Once the learning phase was completed, we presented participants with the case of an agent who planned to perform the target action, as in the previous experiments. We manipulated the agent's knowledge in four levels. The agent either knew about everything the participant had just learned (*full knowledge*), the agent had none of this information (*no knowledge*), the agent only knew the underlying causal structure (*structure knowledge*), or the agent was only aware of the study in which the strength of the statistical association between action and outcome was measured (*strength knowledge*).

Here is an example of the knowledge manipulation in the *strength knowledge* condition: "She knows about the strength of the association between producing Proskine and the occurrence of Marasia illness, that is, how often Marasia illness occurs when Proskine is produced and stored versus not produced and stored (the result of the study of health records). However, she does not know that the relation between producing and storing Proskine and the occurrence of Marasia illness is causal (the causal chain described earlier). To sum up, Mary knows how often Marasia illness occurs when Proskine is present in a lab, but she does not know what the causal relation behind this association is." We provided illustrations to remind participants of both the objective causal structure and strength as well as the agents' knowledge (see Fig. 8 for an example). As in the previous experiments, we requested judgments of moral permissibility before the act was initiated as well as judgments of moral responsibility after the harmful outcome had occurred. Once participants had completed the moral judgment tasks for a scenario, the main information about the case was presented again (summarised on a single page), and participants were asked to provide predictive causal judgments of the probability of the outcome in the presence and absence of the action. Moreover, they were asked to assess agents' foreseeability, and for singular causation judgments. We also asked participants about the agents' knowledge at the time of acting as a manipulation check. An

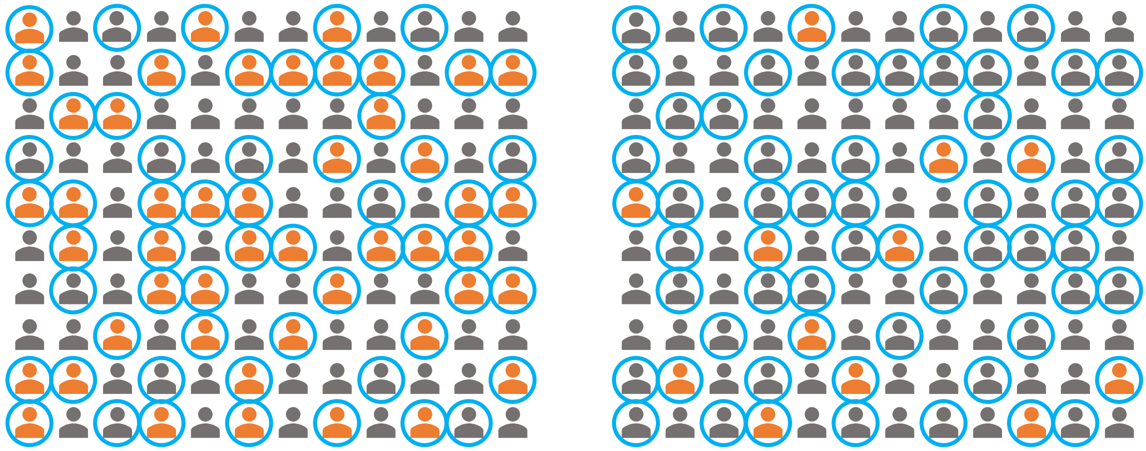

Fig. 7. Learning data used in Experiment 3. Participants were instructed that the presence of a blue circle meant that the target cause (an action) was present, and a red person icon meant that the target effect (a harmful outcome) had occurred. The left panel shows a contingency of .80, the right panel shows a contingency of.20. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

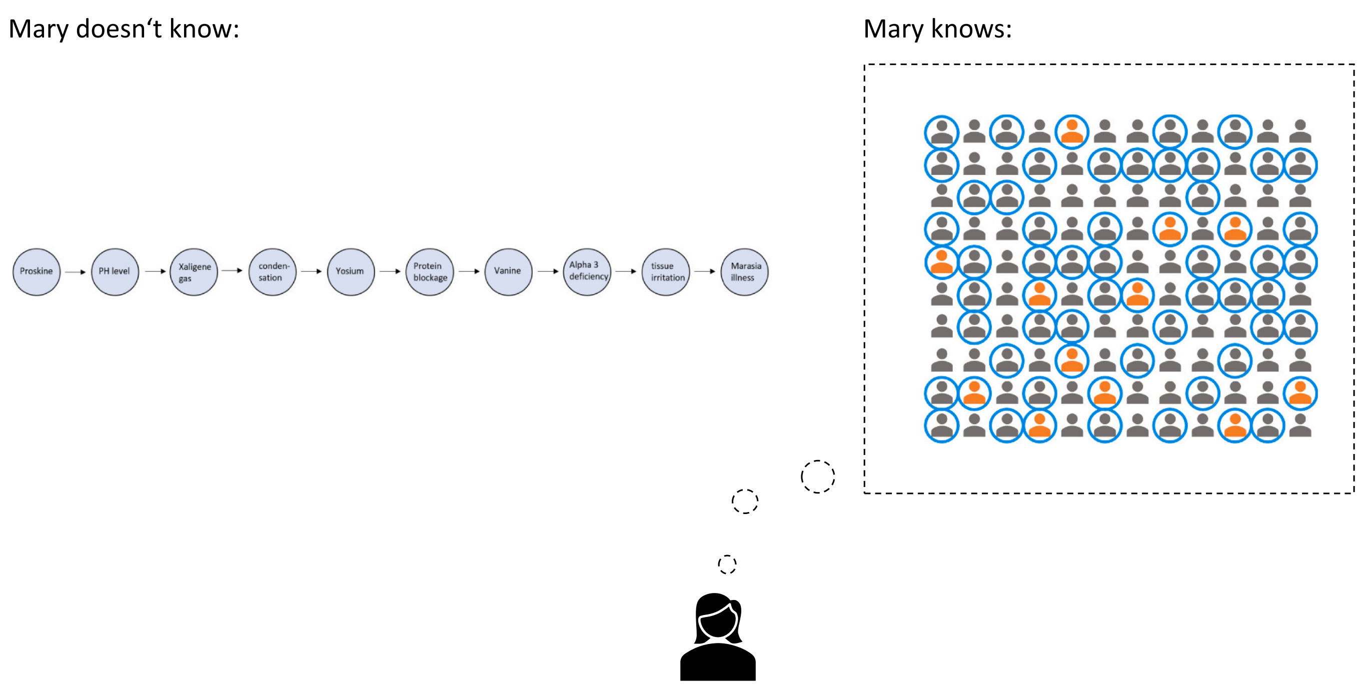

Fig. 8. Example illustration of an agent's knowledge in Experiment 3. Here the agent is aware of the strength of the association between an action and a harmful outcome (right), but unaware of the causal relation behind the association (left).

example for this question is: “When producing and storing Proskine, Mary knew about...”, with the four options “the lab study (that is, the fact that Proskine can cause Marasia illness via a chain of other intermediate events)”, “the study of health records (that is, how often Marasia illness occurs when Proskine is produced and stored)”, “both studies”, or “neither study”.

5.2. Results and discussion

See Fig. 9 for the results for permissibility, responsibility, and foreseeability judgments. Table 13 in the Appendix shows the descriptive statistics for all measures and conditions. Table 8 contains the results of the planned *t*-tests for moral judgments. We fit linear mixed models to the data and determined which combination of predictors best described participants’ responses using model comparisons. For the final models, see Table 9.

As we had hoped to achieve with the larger number of observations in the learning task, participants now perceived the overall causal relations between actions and outcomes to be equally strong in chains and in direct relations. As predicted by the probabilistic model (but not the indirectness model), neither judgments of moral permissibility nor judgments of moral responsibility were robustly affected by causal structure under these circumstances (see Fig. 9, Table 9, Table 8). Judgments of moral permissibility were only affected by causal strength (with lower causal strength leading to higher permissibility ratings, as the probabilistic model predicts), and by the agents’ knowledge. For judgments of moral responsibility, ratings increased with higher causal strength, and were also affected by knowledge. There was a small effect of causal structure on responsibility judgments in a one-sided t-test (see Table 8). However, adding structure to the model did not improve the fit when the other factors were accounted for (see Table 9 and Supplementary Materials). Thus, overall, only causal strength and agents’

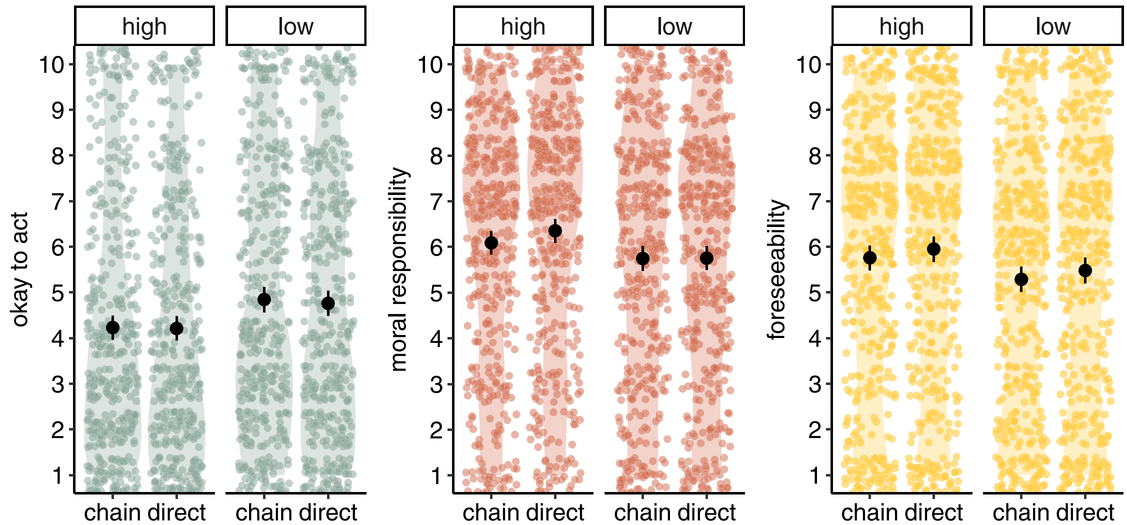

Fig. 9. Means and 95% confidence intervals for ratings of moral permissibility (left), moral responsibility (middle), and foreseeability (right) in Experiment 3. Data are collapsed across knowledge conditions, see Appendix for graphs per knowledge condition.

Table 8
Effects of causal structure (chain vs. direct) and causal strength (high vs. low) on moral judgments in Experiment 3, collapsed across knowledge conditions (see Appendix for tests per knowledge condition). *P*-values are one-tailed.

	Query	*t (df)*	*p*	*d (0.95 CI)*
causal structure	permissibility	0.63 (853)	.26	0.02 (−0.04, 0.08)
	responsibility	−1.75 (853)	0.04	−0.05 (−0.1, 0.01)
causal strength	permissibility	−4.23 (1703.52)	<.001	−0.2 (−0.3,−0.11)
	responsibility	3.54 (1704.91)	<.001	0.17 (0.08, 0.27)

knowledge proved to exert substantial and robust influences on moral judgments.

As for the knowledge manipulation, we found that participants only considered complete ignorance about causal relations to be exculpating. When agents knew about either the structure by which action and harm were related or about the strength of the relation, they were judged to be roughly equally morally responsible and their actions roughly equally impermissible as agents with complete knowledge about the causal relations (see Table 9, for additional graphs per knowledge condition see Fig. 10 – Fig. 13 in the Appendix). The only exception was that agents with only strength knowledge were seen as slightly less morally responsible than agents with full knowledge, $d = 0.16$ [0.03,0.30].

Adding a two-way interaction term between knowledge and strength did not improve the model fit for either moral judgment measure, possibly due to a lack of power for the reliable detection of interaction effects. Nevertheless, descriptively, the largest effects of causal strength on moral judgments were observed when agents were fully aware of causal relations, and no effects of strength could be detected in the no knowledge conditions. Results for partial knowledge were in between (see Fig. 10 – Fig. 13 and Table 14, all in the Appendix). These observations again support the mediating role of foreseeability. Unexpectedly, strength still affected moral judgments when agents were only aware of the causal structure. It may have been difficult for participants to screen off strength information in their moral judgments after the lengthy learning task, or they may have had difficulties to differentiate between states of partial knowledge.

When explicitly asked about outcome foreseeability, participants indicated that agents were less able to foresee harm when causal strength was low rather than high, and also when the relation was direct rather than a chain (see Fig. 9, Table 9). The effect of causal structure is predicted by the indirectness model, but not by the probabilistic model. However, the influence of strength ($d = 0.16$ [0.07,0.26]) was stronger than the influence of structure ($d = 0.07$ [0.02,0.11]). The outcomes were judged as unforeseeable in the no knowledge conditions, and as highly foreseeable in the full knowledge conditions. Partial knowledge (only causal structure, only causal strength) also somewhat reduced perceived foreseeability compared to full knowledge. One might wonder how these results for foreseeability square with the fact that moral judgments were not affected by causal structure or partial knowledge relative to full knowledge, given that we claim that foreseeability attributions mediate effects of the causal model representations on moral judgments. However, we have seen in all of our experiments (here as well as in Engelmann & Waldmann, 2021) that the direct effects of our causal model manipulations on foreseeability are larger than their indirect effects on moral judgments. A relatively large difference in outcome foreseeability seems to be required for moral judgments to be affected. The small effects of structure and foreseeability that we observed here may not have been strong enough to push through to the moral measures.

Singular causation judgments, just as predictive causal judgments, were only affected by causal strength in this experiment, no detectable effects of causal structure was observed (see Table 9). As in Experiment 2, confidence in singular causation correlated with moral responsibility ratings ($r = .41$ [.37,.45], $t_{1706} = 18.82$, $p < .001$). As before, we analyzed whether responsibility judgments were affected by judgments about singular causation, foreseeability attributions, causal structure, and causal strength in a linear regression. In this analysis, only singular causation ($\beta = 0.27$, $t_{1703} = 12.04$, $p < .001$) and foreseeability ($\beta = 0.55$, $t_{1703} = 31.28$, $p < .001$) were significant predictors of moral responsibility judgments. Table 12 in the Appendix shows the correlations between all measures. We provide the results of additional mediation analyses and figures showing participants' response trajectories across the different measures in the Supplementary Materials.

In sum, the results that we obtained here supported the probabilistic model more strongly than the indirectness model. Both moral judgment measures were clearly and consistently affected by the strength of the causal relations between action and harmful outcomes as well as by the agents' knowledge. The dominant pattern was that actions became more permissible and agents less responsible when harm was less likely to be caused by the action. Partial knowledge about causal relations (only strength, only structure) sufficed for moral condemnation of agents and actions. In the conditions in which agents were completely ignorant of the causal relations, no significant effects of strength on judgments of

Table 9
Final regression models for all measures in Exp. 3.

Permissibility				
Random: participant ID	Intercept	Residual		
SD	1.68	1.73		
Fixed: strength, knowledge	Estimate	*SE*	*t (df)*	*p*
low strength	0.58	0.14	4.11 (849)	<.001
no knowledge	3.64	0.20	18.04 (849)	<.001
strength knowledge	0.17	0.20	0.81 (849)	0.42
structure knowledge	0.35	0.20	1.76 (849)	0.08
responsibility				
Random: participant ID	Intercept	Residual		
SD	1.77	1.61		
Fixed: strength, knowledge	Estimate	*SE*	*t (df)*	*p*
low strength	−0.48	0.14	−3.36 (849)	<.001
no knowledge	−3.31	0.20	−16.22 (849)	<.001
strength knowledge	−0.42	0.21	−2.03 (849)	.04
structure knowledge	−0.24	0.20	−1.20 (849)	.23
foreseeability				
Random: participant ID	Intercept	Residual		
SD	1.43	1.41		
Fixed: structure, strength, knowledge	Estimate	*SE*	*t (df)*	*p*
direct	0.19	0.07	2.84 (853	.005
low strength	−0.50	0.12	−4.22 (849)	<.001
no knowledge	−5.51	0.17	−32.52 (849)	<.001
strength knowledge	−1.17	0.17	−6.83 (849)	<.001
structure knowledge	−1.27	0.17	−7.51 (849)	<.001
predictive				
Random: participant ID	Intercept	Residual		
SD	16.38	13.0		
Fixed: strength	Estimate	*SE*	*t (df)*	*p*
low strength	−39.52	1.29	−30.72 (852)	<.001
singular causation				
Random: participant ID	Intercept	Residual		
SD	1.78	1.47		
Fixed: strength	Estimate	*SE*	*t (df)*	*p*
low strength	−0.93	0.14	−6.59 (852)	<.001
p(outcome|no action)				
Random: participant ID	Intercept	Residual		
SD	14.13	12.86		
Fixed: none				

moral permissibility or moral responsibility could be detected. This is in line with the hypothesis that attributions of outcome foreseeability mediate the effect of the causal features on moral judgments (which was also confirmed in Experiment 1, see also mediation analyses in the Supplementary Materials).

The only finding that is more in line with the indirectness model than with the probabilistic model was the observation that causal structure to a small extent affected attributions of outcome foreseeability when *p* (outcome|action) was not only objectively kept constant, but also perceived as constant by participants. Thus, even though participants estimated outcomes as equally likely in the chain and direct relation conditions, they still considered agents to be somewhat less able to foresee the harmful outcome when action and outcome were related via a chain rather than directly. This finding is not predicted by the probabilistic model. The effect was very small, but nevertheless it seems that indirectness can have an effect on attributions of outcome foreseeability that is independent of causal strength. The stronger and more consistently observed effect was, however, that foreseeability is dependent on causal strength, leading to downstream effects on moral judgments.

6. General discussion

Making moral judgments requires causal analysis. We judge people's actions by their anticipated and actual consequences, and we hold them responsible for the good or bad outcomes that they caused. Causal analysis focuses on the causal relations that exist in the world and the strengths of these relations. These two dimensions of causal models, causal structure and causal strength, are the foundation of a number of inferences that are crucial for moral reasoning (see, e.g. Cushman, 2008, 2013; Langenhoff, Wiegmann, Halpern, Tenenbaum, & Gerstenberg, 2021; Sloman, Fernbach, & Ewing, 2009; Waldmann, Wiegmann, & Nagel, 2017). Even though the general claim that causation lies at the heart of moral reasoning is largely undisputed, the specific interplay of causal structure and causal strength in the formation of moral judgments has not yet been investigated in a systematic way. In the present research we aimed to lay the groundwork for such an investigation, starting with the case of direct causal relations in comparison to causal chains.

We focused on chains whose initial element is an intentional action and whose final outcome is some form of harm to another person. The intermediate variables were (bio-)chemical events. In our first experiment we showed that people evaluate agents and actions more positively when agents cause harm via a chain of intermediate events, rather than directly. Specifically, participants in the chain condition considered actions to be more morally permissible *before* they were executed, and they considered agents to be less morally responsible *after* harmful outcomes had actually occurred. Experiment 1 also demonstrated that causal representations did not directly alter moral judgments, but that their effects were mediated by inferences about the agents' mental states. Causal chains tend to lead to the impression that outcomes are less foreseeable to agents, which in turn leads to a more positive moral evaluation.

Experiments 2 and 3 were dedicated to uncovering the cognitive mechanisms that underlie this effect. We contrasted two hypotheses: According to the probabilistic model outcomes are less foreseeable in chains because they are perceived as less likely to occur. On this view, effects of causal structure (chains vs. direct relations) on moral judgments are ultimately dependent on inferences about causal strength. Alternatively, according to what we called the indirectness model, causal structure itself might be driving the effect. On this view, outcomes are perceived as less foreseeable in chains merely because the relation is indirect. The two models make diverging predictions for situations in which the overall causal relationship between action and harm is equally strong in chains as in direct relations. When the overall causal strength is the same, the probabilistic model predicts that there should be no difference between the moral evaluation of a direct and an indirect relation. The indirectness model, on the other hand, predicts that agents and actions should be judged more positively in chains, even when the overall relation between the action and the final outcome is just as strong as in a direct relation.

Varying both causal structure and causal strength in the two experiments we found that the evidence more strongly favoured the probabilistic model. When chains and direct relations were equally strong, no effects of causal structure on judgments of moral permissibility were observed. Although we still observed effects on moral responsibility judgments in some conditions, they were very weak and inconsistent. Causal strength, on the other hand, had a clear effect on both types of moral judgments in both Experiments 2 and 3. Actions were judged as more permissible when harmful consequences were less likely, and agents were seen as less morally responsible when the a priori likelihood of harm was low.

Experiment 3 also shed further light on the kind of foreseeability that affects permissibility and responsibility judgments. It turned out that agents do not need to be aware of all aspects of a causal relation between their action and harm. Knowing that a certain causal relation exists suffices even when its strength is unknown. Likewise, knowing about a statistical association between action and harm suffices, even when the causal structure that underlies the association is unknown. In our experiments, the learning data that participants saw made it very easy to infer the existence of a causal relation between action and harm. We thus suspect that reasoners expected others who are confronted with the same data (i.e., the agents in our scenarios) to arrive at the same conclusion that they themselves drew, namely that the relationship is actually causal. Future studies should investigate in more detail how reasoners' own judgments about relations affect the inferences that they expect others to draw.

Even though the probabilistic model emerged as the dominant path by which causal structure influences moral judgments, we also found some effects that are only predicted by the indirectness model. In Experiment 3, participants considered outcomes as somewhat less foreseeable in chains than in direct relations, even though they took the probabilistic relation to be equally strong in both cases. Thus, it seems that causal structure can have a direct effect on foreseeability. However, the effect was not large enough to robustly affect moral judgments as well. We repeatedly observed that moral evaluations are only altered when outcomes become substantially, not just slightly less foreseeable to agents (see also Engelmann & Waldmann, 2021).

We studied two types of moral judgments, prospective permissibility and retrospective responsibility judgments. Both types of judgments are affected by causal relations and mental states (foreseeability) but whereas prospective judgments rely on predictive causal judgments, our results indicate that retrospective judgments rely on singular causation judgments. We found that participants' confidence in the claim that actions actually caused harmful outcomes in the case at hand predicted their moral responsibility ratings beyond the predictive power of foreseeability attributions. Thus, it seems that both a sufficient level of outcome foreseeability and confidence in singular causation are required for the attribution of moral responsibility. Fully clarifying how singular causation is affected by strength and structure knowledge, and how it in turn interacts with foreseeability to shape judgments of moral responsibility will require systematically manipulating singular causation in future research (but see Cushman, 2008, for a demonstration of the general relevance of singular causation in moral judgments).

6.1. Beyond causal strength and causal structure

Structure and strength are the two crucial components of causal networks. As we have demonstrated in the present research, their interplay, along with the inferences that they license about agents' mental states, can explain patterns in people's moral reasoning. However, there may be additional factors that might affect moral judgments. Some of them may interact with our beliefs about causal structure and causal strength, while others might have other sources.

For example, domain knowledge will probably affect default assumptions about causal structure and causal strength. Strickland et al. (2017) showed that when people reason about events from the physical domain, they tend to represent them as the products of linear causal chains, whereas psychological events are assumed to be the product of many independent causes (common-effect structures, see Fig. 1). Furthermore, causal links in the physical domain were estimated to be stronger than links in the psychological domain. Thus, domain-specific assumptions seem to shape our causal representations in the absence of clear information about structure and strength. To the extent that they do, we would expect moral judgments to follow suit. For example, if all links were perceived to be completely deterministic in a scenario, chain length should no longer affect moral judgments, as multiplying the links would no longer reduce the probability of the outcome in a chain.

A further important property of causal chains that honor the Markov condition is transitivity. That is, if A causes B, and B causes C, people should usually also agree that A causes C. People made this assumption in our experiments, as wis suggested by their singular causation ratings, for example. These ratings were always above the scale midpoint, indicating that participants took actions to have actually caused the final outcomes. Sometimes, however, people do not assume chains to be transitive. (Johnson & Ahn, 2015) proposed that chains tend to be viewed as intransitive when the first and the last element are not part of the same semantic schema, or "chunk". For instance, participants in their experiments agreed that there was a strong causal link between a person stepping on a dog's tail and the dog growling. They also perceived a strong causal link between the dog growling and a child becoming scared. However, the link between stepping on a dog's tail and a child becoming scared was judged to be weak (and weaker than in other cases in which the individual links were perceived as equally strong). We predict that judgments about foreseeability and moral judgments might also vary with perceived strength in such cases. That is, a child becoming scared might be judged as rather unforeseeable given that someone stepped on a dog's tail, and the agent would probably not be seen as very responsible for it. These results are in line with our predictions, though, since in these cases the relation between initial action and final outcome is viewed as weak. Thus, when chains are seen as intransitive because of semantic chunking, even shorter chains than the ones we used in our experiments might lead to a considerably more positive moral evaluation.

Finally, semantic chunking seems to be closely related to preferences about the granularity at which we represent causal relations. Any causal relationship can, in principle, be construed on many different levels of granularity (i.e., very abstract and high-level vs. down to the level of atoms and their interactions). How exactly reasoners choose the appropriate level of granularity for a given relationship is subject to an extensive debate (see, e.g., Woodward, 2021). One plausible factor is whether mediating events constitute suitable targets of intervention whose manipulation would allow some control over the causal relationship (Woodward, 2005). Based on Johnson & Ahn (2015)'s work, another factor may be whether an intermediate event B is required to explain why A leads to C. When instructing long chains in our experiments, we mostly described fairly low-level biochemical mechanisms as intermediate events, involving fictitious substances and devices. We did this in an effort to minimize any effects of knowledge of or assumptions about the strengths of individual links on participants' judgments. However, low-level biochemical mechanisms are not usually what we *care* about in everyday life, unless we have special reason to be interested in them. Thus, the chains we used could have seemed to participants as the results of "zooming in" on a causal relation in which the only interesting parts are the beginning and the end. If this was the case, effects of causal structure on inferences about overall strength, foreseeability, and moral judgments might be more pronounced when the intermediate events seem more relevant to participants.

6.2. Causation and foreseeability in the law

The extent to which agents could foresee or should have foreseen harm that resulted from their actions is not just of crucial importance for moral judgments, it also informs central legal notions such as negligence or recklessness. An agent is typically considered negligent when they cause harm that they should have reasonably foreseen, or that a reasonable person would have foreseen (even if in the actual situation, the agent did not foresee it). Recklessness requires that agents were aware of a substantial risk of harm at the time of acting, and acted despite this knowledge (see, e.g., Dubber, 2015, *pp*. 42–46). Kneer & Skoczeń (2021) and Kneer & Machery (2019) found that judgments that expressed that agents should have foreseen the harms they caused (i.e., attributions of negligence) explained effects that would otherwise be described as instances of moral luck or as direct effects of outcomes on moral judgments. Nobes & Martin (2021) experimentally manipulated negligence and recklessness in cases of accidental harms by instructing that agents forgot about risks (negligence) or ignored known risks (recklessness). They found that either suffices for a negative moral evaluation, and that participants often infer that agents who caused harm were negligent when no information to the contrary was provided.

In our scenarios, agents could also be described as negligent or even reckless in the conditions in which they were aware of the harms they might cause. In the conditions in which they were unaware, attributions of negligence are likely blocked because we always pointed out that agents *could* not possibly have been aware of the risk, as the relevant scientific results were not available to them (i.e., a reasonable person could not have foreseen harm). Thus, the results we reported here are consistent with the view that attributions of negligence or recklessness might influence moral judgments about accidental harms.

In legal discussions of negligence, however, it is generally not only taken into account whether someone should have been able to foresee harm, but also how severe the harm is that they should have been able to foresee, and whether the burden of taking reasonable precautions against harm would have been acceptable. In *United States v. Carroll Towing Co.* (1947) a formula is famously suggested according to which an act should *not* count as negligent when the burden of taking adequate precautions would have outweighed the severity of harm, multiplied by its probability. Thus, it is possible for agents to reasonably foresee harm, and still not be deemed negligent. If harm is a side effect, one might furthermore add the probability and utility of the primary goal that an agent was pursuing with their action (see Engelmann & Waldmann, 2022; Waldmann & Wiegmann, 2012). Future studies need to investigate the interplay of these factors in laypeople's judgments. We suspect that people will not condemn just any foreseeable harm, but that their attributions might instead roughly reflect the conditions that are specified in the formula cited above. Anecdotally, we can report that many participants in our studies remarked that they wondered whether agents took adequate precautions to prevent harm.

6.3. Conclusion

We set out to test how causal structure and causal strength affect moral judgments about causal chains. When agents caused harms via a longer chain of intermediate events, rather than directly, participants saw actions as more permissible, and agents as less morally responsible. We demonstrated that this effect mainly arises because reasoners take harm to be less likely, and therefore less foreseeable to agents in chains. Thus, effects of causal structure were predominantly mediated by inferences about causal strength and about agents' mental states. The mere indirectness of a relation can also lower foreseeability, but these differences were mostly not strong enough to change moral evaluations. Future research should investigate the interplay between chain length and semantic chunking or granularity, as well as how foreseeability interacts with the utility of agents' primary goals and the perceived burden of taking adequate precautions against harm.

CRediT authorship contribution statement

Neele Engelmann: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Michael R. Waldmann**: Conceptualization, Writing – review & editing, Supervision.

Acknowledgments

We would like to thank Alex Wiegmann for helpful comments. We also thank Jonathan F. Kominsky, an anonymous reviewer, as well as audiences at the Georgetown Law and Language Lab, and the Chicago/Michigan Psychological and Law Studies Lab. Portions of this work have appeared in the *Proceedings of the Cognitive Science Society*: Engelmann, N., & Waldmann, M. R. (2021). A causal proximity effect in moral judgment. In *Proceedings of the 43th Annual Conference of the Cognitive Science Society* (pp. 2330 - 2336). Austin, TX: Cognitive Science Society.

Appendix A

Table 10
Correlations between all measures of Experiment 1. All $p < .001$ (unadjusted).

	Perm.	Resp.	Foresee	Pred.
perm.		−0.57	−0.53	−0.30
resp.	−0.57		0.64	0.33
foresee	−0.53	0.64		0.33
pred.	−0.30	0.33	0.33	

Table 11
Correlations between all measures of Experiment 2. All $p < .001$ (unadjusted) except between responsibility and $p(E|noC)$ ($p = 0.50$).

	Perm.	Resp.	Foresee	Pred.	Singular	$p(E\|noC)$
perm.		−0.46	−0.44	−0.41	−0.43	0.14
resp.	−0.46		0.53	0.31	0.55	−0.03
foresee	−0.44	0.53		0.38	0.58	−0.13
pred.	−0.41	0.31	0.38		0.40	0.14
singular	−0.43	0.55	0.58	0.40		−0.15
$p(E\|noC)$	0.14	−0.03	−0.13	0.14	−0.15	

Table 12
Correlations between all measures in Experiment 3. All $p < .001$ (unadjusted) except between permissibility and $p(E|noC)$ ($p = .002$), and between foreseeability and $p(E|noC)$ ($p = .002$).

	Perm.	Resp.	Foresee	Pred.	Singular	p(E|nonC)
perm.		−0.60	−0.58	−0.15	−0.24	0.08
resp.	−0.60		0.65	0.16	0.41	−0.11
foresee	−0.58	0.65		0.12	0.32	−0.07
pred.	−0.15	0.16	0.12		0.31	0.08
singular	−0.24	0.41	0.32	0.31		−0.26
p(E|nonC)	0.08	−0.11	−0.07	0.08	−0.26	

Table 13
Descriptive statistics per condition in Exp. 3.

	Chain		Direct		
full knowledge, high strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	3	1.89	3.05	2.14	98
responsibility	7.23	2.15	7.59	2.07	
foreseeability	7.81	1.84	8.17	1.74	
predictive	71.54	21.06	74.98	18.89	
singular	7.45	2.15	7.89	1.95	
p(outcome|no action)	15.72	20.6	12.98	16.61	
full knowledge, low strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	3.89	2.47	3.86	2.53	110
responsibility	6.75	2.64	6.43	2.59	
foreseeability	7.27	2.3	7.27	2.34	
predictive	31.74	19.42	32.41	21.47	
singular	6.64	2.68	6.69	2.65	
p(outcome|no action)	11.91	20.86	11.71	21.78	
no knowledge, high strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	6.98	2.94	6.94	2.78	108
responsibility	3.43	2.41	3.89	2.7	
foreseeability	2.34	2.07	2.26	1.84	
predictive	69.44	22.53	72.75	17.08	
singular	7.38	1.89	7.42	2.15	
p(outcome|no action)	12.48	17.98	12.16	16.44	
no knowledge, low strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	7.41	2.84	7.08	3.01	108
responsibility	3.64	2.7	3.75	2.59	
foreseeability	1.87	1.3	1.99	1.54	
predictive	33.11	26.87	34.96	26.92	
singular	6.3	2.92	6.66	2.73	
p(outcome|no action)	13.31	23.89	13.53	22.85	
strength knowledge, high strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	3.32	1.99	3.42	2.06	113
responsibility	6.88	2.01	6.72	2.33	
foreseeability	6.73	1.98	6.94	2.07	
predictive	72.47	17.84	73.23	16.76	
singular	7.57	1.86	7.53	2.09	
p(outcome|no action)	9.54	17.06	11.57	18.24	
strength knowledge, low strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	4.02	2.3	3.72	2.23	97
responsibility	6.14	2.61	6.55	2.31	
foreseeability	5.88	2.32	6.25	2.22	
predictive	36.51	23.22	35.44	23.32	
singular	6.49	2.59	7.02	2.38	
p(outcome|no action)	11.21	20.12	12.25	22.3	
structure knowledge, high strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	3.56	2.11	3.36	2.19	108
responsibility	6.88	2.21	7.31	2.06	
foreseeability	6.3	2.02	6.59	1.94	
predictive	73.06	18.02	74.47	16.06	
singular	7.94	1.75	7.95	1.71	
p(outcome|no action)	9.82	12.3	11.69	16.06	
structure knowledge, low strength	***M***	***SD***	***M***	***SD***	***n***
permissibility	4.03	2.28	4.3	2.44	112
responsibility	6.46	2.21	6.34	2.42	
foreseeability	6.12	2.09	6.42	2.22	
predictive	32.98	23.25	29.28	18.58	
singular	7.1	2.36	6.78	2.57	
p(outcome|no action)	7.62	18.54	7.71	16.58	

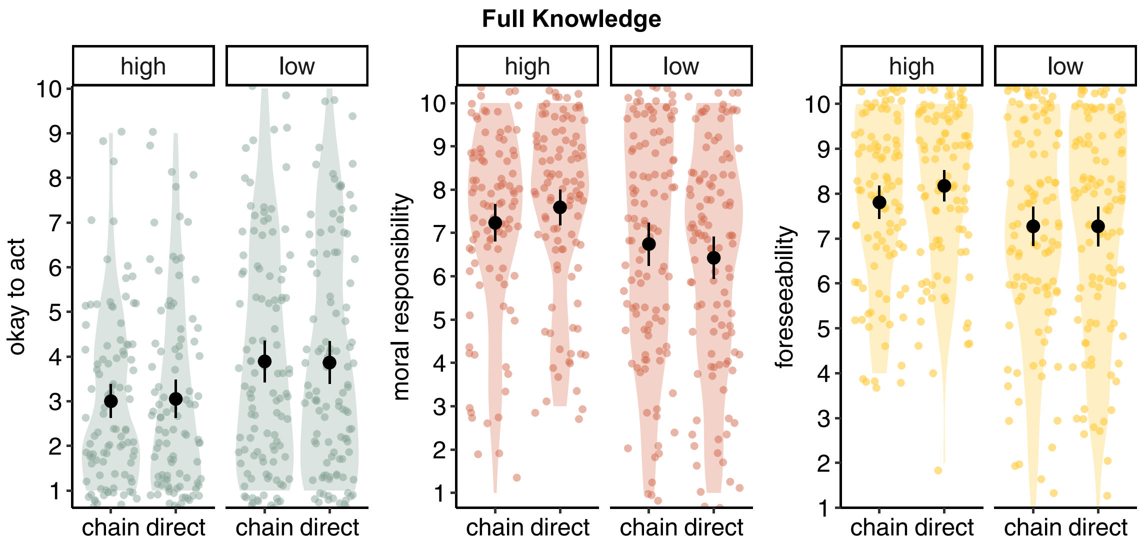

Fig. 10. Means and 95% CIs for ratings of moral permissibility (left), moral responsibility (middle), and foreseeability (right) in the full knowledge conditions of Experiment 3.

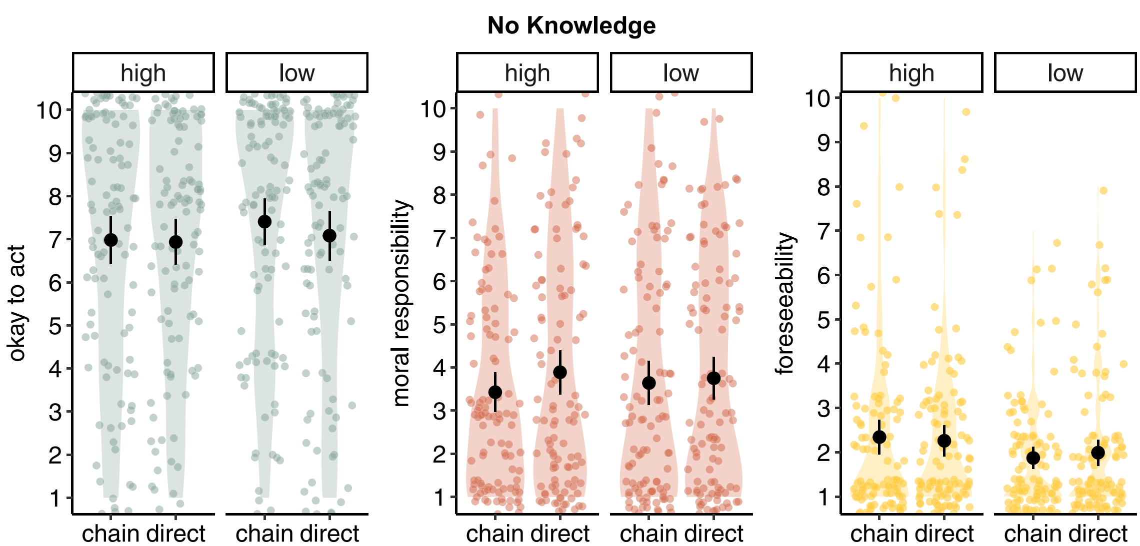

Fig. 11. Means and 95% CIs for ratings of moral permissibility (left), moral responsibility (middle), and foreseeability (right) in the no knowledge conditions of Experiment 3.

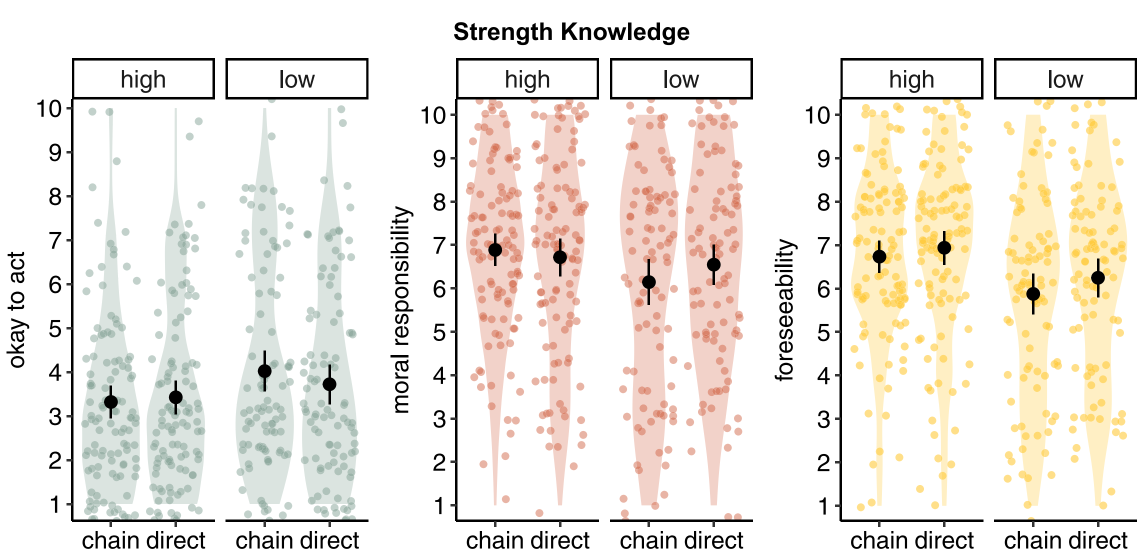

Fig. 12. Means and 95% CIs for ratings of moral permissibility (left), moral responsibility (middle), and foreseeability (right) in the strength knowledge conditions of Experiment 3.

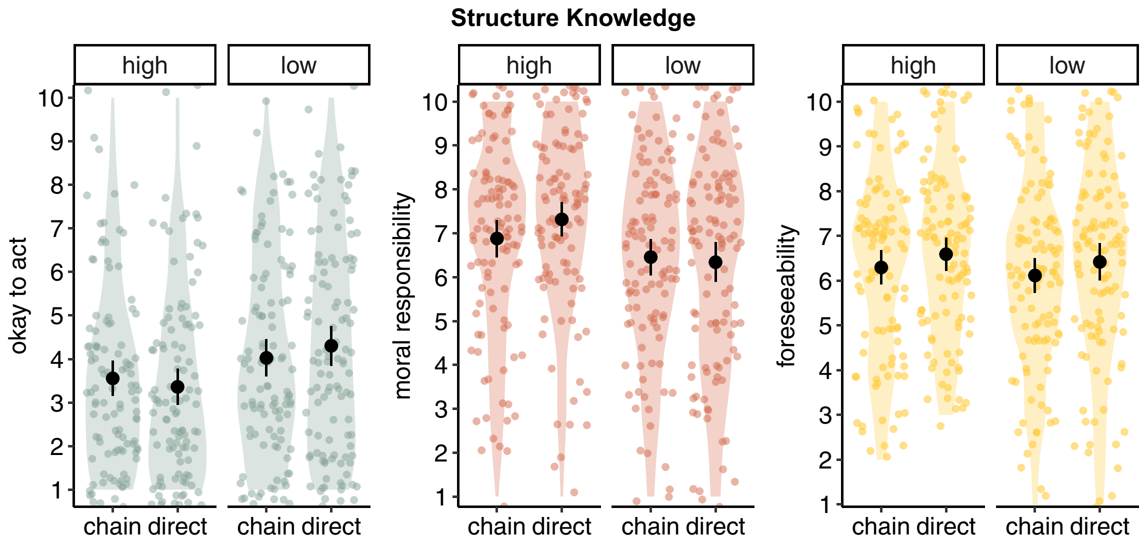

Fig. 13. Means and 95% CIs for ratings of moral permissibility (left), moral responsibility (middle), and foreseeability (right) in the structure knowledge conditions of Experiment 3.

Table 14
Effects of causal structure and causal strength on judgments of moral permissibility and moral responsibility per knowledge condition in Exp. 3.

	Knowledge	Query	*t (df)*	*p*	*d (0.95 CI)*
causal structure	full	permissibility	−0.06 (207)	.52	0.0 (−0.14, 0.13)
		responsibility	0 (207)	.50	0 (−0.14, 0.14)
	none	permissibility	1.11 (215)	.13	0.06 (−0.05, 0.18)
		responsibility	−1.95 (215)	.03	−0.11 (−0.22, 0)
	strength	permissibility	0.43 (209)	.34	0.04 (−0.14, 0.21)
		responsibility	−0.60 (209)	0.27	−0.04 (−0.17, 0.09)
	structure	permissibility	−0.29 (219)	.62	−0.02 (−0.15, 0.11)
		responsibility	−1.04 (219)	.15	−0.07 (−0.2, 0.06)
causal strength	full	permissibility	−3.84 (410.14)	<.001	−0.37 (−0.57, −0.18)
		responsibility	3.56 (410.10)	<.001	0.35 (0.15, 0.54)
	none	permissibility	−1.03 (429.79)	.15	−0.10 (−0.29, 0.09)
		responsibility	−0.15 (429.63)	.56	−0.01 (−0.20, 0.17)
	strength	permissibility	−2.36 (390.13)	.009	−0.23 (−0.43, −0.04)
		responsibility	1.99 (387.89)	.02	0.20 (0, 0.39)
	structure	permissibility	−3.29 (436.52)	<.001	−0.31 (−0.50, −0.12)
		responsibility	3.29 (437.29)	<.001	0.31 (0.13, 0.50)

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cognition.2022.105167.

References

Alicke, M. D. (2000). Culpable control and the psychology of blame. *Psychological Bulletin, 126*(4), 556–574. https://doi.org/10.1037/0033-2909.126.4.556

Anderson, R. A., Kamtekar, R., Nichols, S., & Pizarro, D. A. (2021). False positive emotions, responsibility, and moral character. *Cognition, 214*, 104770. https://doi.org/10.1016/j.cognition.2021.104770

Balduzzi, S., Rücker, G., & Schwarzer, G. (2019). How to perform a meta-analysis with R: a practical tutorial. *Evidence-Based Mental Health, 22*, 153–160. https://doi.org/10.1136/ebmental-2019-300117

Bes, B., Sloman, S., Lucas, C. G., & Raufaste, E. (2012). Non-bayesian inference: Causal structure trumps correlation. *Cognitive Science, 36*(7), 1178–1203. https://doi.org/10.1111/j.1551-6709.2012.01262.x

Calderon, S., Mac Giolla, E., Ask, K., & Granhag, P. A. (2020). Subjective likelihood and the construal level of future events: A replication study of Wakslak, Trope, Liberman, and Alony (2006). *Journal of Personality and Social Psychology, 119*(5), e27–e37. https://doi.org/10.1037/pspa0000214

Cheng, P. W. (1997). From covariation to causation: A causal power theory. *Psychological Review, 104*(2), 367. https://doi.org/10.1037/0033-295X.104.2.367

Cheng, P. W., & Novick, L. R. (1990). A probabilistic contrast model of causal induction. *Journal of Personality and Social Psychology, 58*(4), 545–567.

Cheng, P. W., & Novick, L. R. (1991). Causes versus enabling conditions. *Cognition, 40*(1–2), 83–120. https://doi.org/10.1016/0010-0277(91)90047-8

Cheng, P. W., & Novick, L. R. (2005). Constraints and nonconstraints in causal learning: Reply to White (2005) and to Luhmann and Ahn (2005). *Psychological Review, 112*, 694–706. https://doi.org/10.1037/0033-295X.112.3.694

Cushman, F. (2008). Crime and punishment: Distinguishing the roles of causal and intentional analyses in moral judgment. *Cognition, 108*(2), 353–380. https://doi.org/10.1016/j.cognition.2008.03.006

Cushman, F. (2013). Action, outcome, and value: A dual-system framework for morality. *Personality and Social Psychology Review, 17*(3), 273–292. https://doi.org/10.1177/1088868313495594

Dahl, D. B., Scott, D., Roosen, C., Magnusson, A., & Swinton, J. (2019). xtable: Export Tables to LaTeX or HTML. *R package version 1.*, 4–8.

Driver, J. (2008). Attributions of causation and moral responsibility. In W. Sinnott-Armstrong (Ed.), *Moral psychology, Vol. 2. The cognitive science of morality: Intuition and diversity* (pp. 423–439). Cambridge, MA: MIT Press.

Dubber, M. D. (2015). *An introduction to the model penal code.* New York: Oxford University Press.

Engelmann, N., & Waldmann, M. R. (2021). A causal proximity effect in moral judgment. In *, 43. Proceedings of the Annual Meeting of the Cognitive Science Society* (pp. 2330–2336). Cognitive Science Society.

Engelmann, N., & Waldmann, M. R. (2022). How to weigh lives. a computational model of moral judgment in multiple-outcome structures. *Cognition, 218*, 104910. https://doi.org/10.1016/j.cognition.2021.104910

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G* power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191.
Fincham, F., & Jaspars, J. (1983). A subjective probability approach to responsibility attribution. *British Journal of Social Psychology, 22*(2), 145–161. https://doi.org/10.1111/j.2044-8309.1983.tb00575.x
Gopnik, A., & Schulz, L. (2007). *Causal learning: Psychology, philosophy, and computation*. New York: Oxford University Press.
Griffiths, T. L., & Tenenbaum, J. B. (2005). Structure and strength in causal induction. *Cognitive Psychology, 51*(4), 334–384. https://doi.org/10.1016/j.cogpsych.2005.05.004
Hagmayer, Y., & Engelmann, N. (2020). Asking questions to provide a causal explanation - Do people search for the information required by cognitive psychological theories? In E. A. Bar-Asher Siegal, & N. Boneh (Eds.), *Perspectives on causation: Selected papers from the Jerusalem 2017 workshop, Jerusalem studies in philosophy and history of science* (pp. 121–147). Cham: Springer International Publishing.
Harrell, F. E. Jr. (2020). Hmisc: Harrell Miscellaneous. *R package version 4*, 2–4.
Hart, H. L. A., & Honoré, T. (1985). *Causation in the law*. New York: Oxford University Press.
Hertwig, R., Barron, G., Weber, E. U., & Erev, I. (2004). Decisions from experience and the effect of rare events in risky choice. *Psychological Science, 15*(8), 534–539. https://doi.org/10.1111/j.0956-7976.2004.00715.x
Hertwig, R., Hogarth, R. M., & Lejarraga, T. (2018). Experience and description: Exploring two paths to knowledge. *Current Directions in Psychological Science, 27*(2), 123–128. https://doi.org/10.1177/0963721417740645
Hilton, D. J., McClure, J., & Sutton, R. M. (2010). Selecting explanations from causal chains: Do statistical principles explain preferences for voluntary causes? *European Journal of Social Psychology, 40*(3), 383–400. https://doi.org/10.1002/ejsp.623
Johnson, J. T., & Drobny, J. (1985). Proximity biases in the attribution of civil liability. *Journal of Personality and Social Psychology, 48*(2), 283. https://doi.org/10.1037/0022-3514.48.2.283
Johnson, S. G., & Ahn, W.-k. (2015). Causal networks or causal islands? The representation of mechanisms and the transitivity of causal judgment. *Cognitive Science, 39*(7), 1468–1503. https://doi.org/10.1111/cogs.12213
Kassambara, A. (2020). *ggpubr: 'ggplot2' Based Publication Ready Plots. R package version 0.4.0*.
Kelley, K. (2020). *MBESS: The MBESS R Package. R package version 4.8.0*.
Kirfel, L., & Lagnado, D. (2021). Causal judgments about atypical actions are influenced by agents' epistemic states. *Cognition, 212*, 104721. https://doi.org/10.1016/j.cognition.2021.104721
Kneer, M., & Machery, E. (2019). No luck for moral luck. *Cognition, 182*, 331–348. https://doi.org/10.1016/j.cognition.2018.09.003
Kneer, M., & Skoczeń, I. (2021). Outcome effects, moral luck and the hindsight. *Bias*. Available at SSRN https://ssrn.com/abstract=3810220.
Knobe, J., & Shapiro, S. (2021). Proximate cause explained. *The University of Chicago Law Review, 88*(1), 165–236.
Lagnado, D. A., & Channon, S. (2008). Judgments of cause and blame: The effects of intentionality and foreseeability. *Cognition, 108*(3), 754–770. https://doi.org/10.1016/j.cognition.2008.06.009
Lagnado, D. A., & Gerstenberg, T. (2017). Causation in legal and moral reasoning. In M. R. Waldmann (Ed.), *The Oxford handbook of causal reasoning* (pp. 565–602). New York: Oxford University Press.
Langenhoff, A. F., Wiegmann, A., Halpern, J. Y., Tenenbaum, J. B., & Gerstenberg, T. (2021). Predicting responsibility judgments from dispositional inferences and causal attributions. *Cognitive Psychology, 129*, 101412. https://doi.org/10.1016/j.cogpsych.2021.101412
Lawrence, M. A. (2016). ez: Easy analysis and visualization of factorial experiments. *R package version 4.4-0*.
Livengood, J., & Sytsma, J. (2020). Actual causation and compositionality. *Philosophy of Science, 87*(1), 43–69. https://doi.org/10.1086/706085
Maier, M., Bartoš, F., Oh, M., Wagenmakers, E., Shanks, D., & Harris, A. J. L. (2022). *Publication bias in research on construal level theory*. Available at https://psyarxiv.com/r8nyu/.
Mangiafico, S. (2021). *rcompanion: Functions to Support Extension Education Program Evaluation. R package version 2.4.0*.
Mayrhofer, R., & Waldmann, M. R. (2015). Agents and causes: Dispositional intuitions as a guide to causal structure. *Cognitive Science, 39*(1), 65–95. https://doi.org/10.1111/cogs.12132
McClure, J., Hilton, D. J., & Sutton, R. M. (2007). Judgments of voluntary and physical causes in causal chains: Probabilistic and social functionalist criteria for attributions. *European Journal of Social Psychology, 37*(5), 879–901. https://doi.org/10.1002/ejsp.394
Meder, B., & Mayrhofer, R. (2017). Diagnostic causal reasoning with verbal information. *Cognitive Psychology, 96*, 54–84. https://doi.org/10.1016/j.cogpsych.2017.05.002
Meder, B., Mayrhofer, R., & Waldmann, M. R. (2014). Structure induction in diagnostic causal reasoning. *Psychological Review, 121*(3), 277. https://doi.org/10.1037/a0035944
Nobes, G., & Martin, J. W. (2021). They should have known better: The roles of negligence and outcome in moral judgments of accidental actions. *British Journal of Psychology, 113*(2), 370–395. https://doi.org/10.1111/bjop.12536
Paharia, N., Kassam, K. S., Greene, J. D., & Bazerman, M. H. (2009). Dirty work, clean hands: The moral psychology of indirect agency. *Organizational Behavior and Human Decision Processes, 109*(2), 134–141. https://doi.org/10.1016/j.obhdp.2009.03.002
Pearl, J. (2000). *Causality: models, reasoning and inference*. Cambridge, UK: Cambridge University Press.
Pearl, J., & Mackenzie, D. (2019). The book of why: The new science of cause and effect. *Penguin Books*.
Perales, J. C., Catena, A., Cándido, A., & Maldonado, A. (2017). Rules of causal judgment: Mapping statistical information onto causal beliefs. In M. R. Waldmann (Ed.), *The Oxford handbook of causal reasoning* (pp. 29–51). New York: Oxford University Press.
Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., & R. Core Team. (2020). nlme: Linear and nonlinear mixed effects models. *R package version 3*, 1–149.
R. Core Team. (2020). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.
Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02
Rottman, B. M., & Hastie, R. (2014). Reasoning about causal relationships: Inferences on causal networks. *Psychological Bulletin, 140*(1), 109–139. https://doi.org/10.1037/a0031903
Royzman, E. B., & Baron, J. (2002). The preference for indirect harm. *Social Justice Research, 15*(2), 165–184.
RStudio Team. (2020). *RStudio: Integrated development environment for R. RStudio*. Boston, MA: PBC.
Rudy-Hiller, F. (2018). The epistemic condition for moral responsibility. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy*. Metaphysics Research Lab, Stanford University. Fall 2018 edition.
Samland, J., & Waldmann, M. R. (2016). How prescriptive norms influence causal inferences. *Cognition, 156*, 164–176. https://doi.org/10.1016/j.cognition.2016.07.007
Schwenkler, J., & Sievers, E. (2022). Cause, "cause", and norm. In P. Willemsen, & A. Wiegmann (Eds.), *Advances in experimental philosophy of causation*. Bloomsbury.
Sloman, S. (2005). *Causal models: How people think about the world and its alternatives*. New York: Oxford University Press.
Sloman, S., Fernbach, P. M., & Ewing, S. (2009). Causal models: The representational infrastructure for moral judgment. *Psychology of Learning and Motivation, 50*, 1–26. https://doi.org/10.1016/S0079-7421(08)00401-5
Spellman, B. A. (1997). Crediting causality. *Journal of Experimental Psychology: General, 126*(4), 323–348. https://doi.org/10.1037/0096-3445.126.4.323
Spirtes, P., Glymour, C. N., & Scheines. (1993). *Causation, prediction, and search*. New York: Springer.
Steiger, J. H. (2004). Beyond the f test: Effect size confidence intervals and tests of close fit in the analysis of variance and contrast analysis. *Psychological Methods, 9*(2), 164–182. https://doi.org/10.1037/1082-989X.9.2.164
Stephan, S., Tentori, K., Pighin, S., & Waldmann, M. R. (2021). Interpolating causal mechanisms: The paradox of knowing more. *Journal of Experimental Psychology: General, 150*(8), 1500–1527. https://doi.org/10.1037/xge0001016
Stephan, S., & Waldmann, M. R. (2018). Preemption in singular causation judgments: A computational model. *Topics in Cognitive Science, 10*(1), 242–257. https://doi.org/10.1111/tops.12309
Strickland, B., Silver, I., & Keil, F. C. (2017). The texture of causal construals: Domain-specific biases shape causal inferences from discourse. *Memory & cognition, 45*(3), 442–455.
Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). Mediation: R package for causal mediation analysis. *Journal of Statistical Software, 59*(5), 1–38.
Torchiano, M. (2020). *effsize: Efficient effect size computation. R package version 0.8.1*.
Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review, 117*(2), 440–463.
Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with S*. New York: Springer. Fourth edition.
Waldmann, M. R. (2017). *The Oxford handbook of causal reasoning*. New York: Oxford University Press.
Waldmann, M. R., & Wiegmann, A. (2012). The role of the primary effect in the assessment of intentionality and morality. In *, 34. Proceedings of the annual meeting of the cognitive science society*. Cognitive Science Society.
Waldmann, M. R., Wiegmann, A., & Nagel, J. (2017). Causal models mediate moral inferences. In J. F. Bonnefon, & B Trémolière (Eds.), *Moral inferences* (pp. 45–63). Psychology Press.
Wickham, H. (2007). Reshaping data with the reshape package. *Journal of Statistical Software, 21*(12), 1–20. https://doi.org/10.18637/jss.v021.i12
Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., … Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software, 4*(43), 1686. https://doi.org/10.21105/joss.01686

Wiegmann, A., & Waldmann, M. R. (2014). Transfer effects between moral dilemmas: A causal model theory. *Cognition, 131*(1), 28–43. https://doi.org/10.1016/j.cognition.2013.12.004

Woodward, J. (2005). *Making things happen: A theory of causal explanation*. New York: Oxford University Press.

Woodward, J. (2021). *Causation with a human face: Normative theory and descriptive psychology*. New York: Oxford University Press.

Zeileis, A., & Hothorn, T. (2002). Diagnostic checking in regression relationships. *R News, 2*(3), 7–10.

Žeželj, I. L., & Jokić, B. R. (2014). Replication of experiments evaluating impact of psychological distance on moral judgment. *Social Psychology, 45*(3), 223–231. https://doi.org/10.1027/1864-9335/a000188

Ziano, I., Wang, Y. J., Sany, S. S., Ho, N. L., Lau, Y. K., Bhattal, I. K., , … Chan, H. Y. C., et al. (2021). Perceived morality of direct versus indirect harm: Replications of the preference for indirect harm effect. *Meta-Psychology, 5*. https://doi.org/10.15626/MP.2019.2134

Zultan, R., Gerstenberg, T., & Lagnado, D. A. (2012). Finding fault: Causality and counterfactuals in group attributions. *Cognition, 125*(3), 429–440. https://doi.org/10.1016/j.cognition.2012.07.014